Opportunities and Challenges for the Use of Artificial Intelligence in Border Control, Migration and Security

Volume 1: Main Report

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Directorate-General for Migration and Home Affairs
Directorate B – Borders, Interoperability and Innovation
Unit B.3: Information Systems for Borders, Migration and Security

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Table of Contents

Table of Figures

Table of Tables

Executive summary

Artificial Intelligence (AI) has been a key topic across business sectors during recent years and is seen a main factor for disruptive innovation in the years to come. The term, as defined by the European Commission, refers to "systems that display intelligent behaviour by analysing their environment and taking actions - with some degree of autonomy to achieve specific goals". Thus, we can think of AI as any system capable of doing things which we would normally regard as intelligent in humans. For AI applications today, this typically comes in the form of recognising patterns, making inferences, taking case-by-case decisions or engaging in conversation. Indeed, it is important to recognise AI as an umbrella term, covering various technologies each designed to solve a particular kind of problem. AI as a concept and a field of research has existed since the 1950s. However, several key drivers are contributing to the acceleration in industry adoption that it is observed today. The amount of data available for AI models to learn from is greater than ever before, and continues to grow at pace. At the same time, increasing democratisation of algorithms and platforms has created an ecosystem in which AI solutions can be tested and implemented more easily, by a wider range of people and organisations.

This study explored how AI can be leveraged in the context of Border Control, Migration and Security. It is clear that the impact of AI on these areas is not identical around the world. Moreover, the market of AI products and solutions is relatively young, and thus remains fragmented across and within most countries. The first part of the study showed that it is important to be aware that increasingly advanced AI, unless properly designed and governed, can demonstrate the more controversial sides of human-like behaviour as well. These include various forms of bias in decision-making, as well as raising questions around transparency, privacy and accountability. Moreover, this study assessed the areas and identified opportunities where AI can positively impact the domains of borders control, migration and security. To do so, the study looked at global and domain-specific trends, use cases, products and success stories in the AI field. The study then looked at nine internal and external processes related to border, migration and security management in the European Union, to assess the potential application of AI. The approach taken was to document the main sub-processes, challenges, data points and systems in use for these processes, and it was within this context that use cases were derived and then prioritised.

The objective of this report (which forms the second part of the study) is to describe how DG HOME and other relevant stakeholders (such as European Union member states, eu-LISA, Frontex, and other agencies) can transform the opportunities identified in the first stage of the study into a programme of work for implementation (referred to as "the roadmap"). The second objective is to describe how this specific programme can be governed, monitored and updated in the future, linked to the working context of the European Commission.

The methodology used to develop the roadmap consists of different steps. First, the identified use cases (referred to as "opportunities") are grouped into nine initiatives, each related to a process examined in the first phase of the study. The rationale for creating initiatives is threefold. First, initiatives provide a good way to structure project management across different opportunities. Furthermore, the initiatives provide a comprehensive view on the upcoming developments most relevant for a stakeholder group (e.g. visa policy officers). Finally, grouping into initiatives provides a good way to ensure accountability, both during and after development, while also ensuring synergies within the initiative are fully leveraged.

A brief description of the overall objective for each initiative is provided below:

- **Initiative 1 (Visa):** The objective of this initiative is to smoothen the visa application process both for applicants as for visa workers, both from a time consuming perspective as user-friendliness. Secondly, the aim is to strengthen the internal security of the Schengen Area by means of improved background checks performed by visa officers.
- **Initiative 2 (ETIAS):** Similar to initiative 1, but then focused for the ETIAS process. Thus, focused on smoothening the process while ensuring security of the Schengen Area.
- **Initiative 3 (Long-term stay or migration):** This initiative covers the process for applying for long-term stay or migration within the EU. The objective of this initiative is to, similarly as the previous, smoothen the application process while ensuring the security of the Schengen Area by means of appropriate background tests.
- **Initiative 4 (Granting international protection):** Here the process for requesting (or granting) international protection is tackled. The objective is to ensure a more transparent, data driven approach to ensure appropriate decisions are made to help those in need. Additionally, follow-up on individuals that are under review and prevent related absconsion.
- **Initiative 5 (SIS and SIRENE Bureaux):** The objective of this initiative is to make better use of data stored in the SIS system resulting in increase in the number alerts solved. Secondly, the objective is to facilitate new entries into the system while ensuring data quality.
- **Initiative 6 (Schengen border checks):** The initiative is focusing on the border checks process at the external Schengen borders. The ultimate objective is to improve and ensure seamless and secure border crossings into the European Schengen Area.
- **Initiative 7 (Operational management of IT systems):** This seventh initiative is focused on the Operational Management of Large-Scale IT systems in the Area of Freedom, Security and Justice (eu-LISA). Practically this leads the Agency to build and to ensure the uninterrupted operation of large-scale IT systems.
- **Initiative 8 (Policymaking):** The objective of this initiative is to ensure that policy making is effective in the sense that it meets the intended goals and needs. Moreover, the objective is also to facilitate the enforcement process (e.g. checking the national enactment or application of legislation).
- **Initiative 9 (Transversal (or "cross-process") opportunities):** This initiative covers opportunities, which do not fit exclusively in one specific process group (and thus initiative). It has various elements that can work across, or augment, other AI opportunities.

Each of the initiatives are further detailed in this report along different aspects such as objective and scope, expected benefits, risks, challenges, involved stakeholders, and relevant key performance indicators (KPIs).

In the second step of developing the roadmap, each of the opportunities within an initiative are assessed in terms of complexity.

This complexity score will have an impact on the duration of implementation projects. To perform this assessment, the feasibility scores[1] obtained in the first phase of the study are used together with new insights provided by process experts (e.g. comments on required regulation changes, technology maturity, etc.) to allocate opportunities into low, medium and high complexity categories. These are mapped respectively to six, twelve and eighteen month end-to-end implementation durations.

In the third step of developing the roadmap, the opportunities are sequenced in accordance with a number of factors. In brief, six main factors were considered with different levels of importance: dependencies (e.g. existing timelines such as ETIAS), value/feasibility ratios (a metric to identify "quick wins", as developed in

[1] Feasibility score is a weighted average of eight different criteria used to assess requisite effort and overall possibility for developing and using the solution. For more information see 0.

the first part of this study), strategic drivers (specific goals of DG HOME and wider European Commission), logical sequences (to start small and grow incrementally), technological factors (to leverage synergies and create expertise within the organisation) and finally balanced workload (to avoid having too many initiatives in progress simultaneously).

The resultant roadmap is presented below as a graphic, displaying the expected start and end time for implementation of each of the prioritised opportunities. The full roadmap covers a little more than five years (beginning Q3 2020)[2] to, on the one hand, give a sufficiently long horizon for developing the opportunities, while on the other to ensure commitment and capacity for the upcoming activities. The first year is relatively light on AI opportunity development as broader preparations (for funding, procurement, stakeholder engagement) need to happen first. Therefore, only select Proof-of-Concepts (see section 5.1.2) will happen in the first year along with over-arching enabling activities (known as "enablers", see chapter 6).

Another element on the roadmap is the way that opportunities are clustered into five different groups, identified mostly from a technical perspective (while the groups are not strictly defined by technology, the particulars of an AI application in each of these groups is sufficiently different to classify in this way):

- **Chatbots and intelligent agents[3]**
- **Risk assessment tools**
- **Knowledge management tools**
- **Policy insight and analytics tools**
- **Computer vision tools**

The graphical figures further down provide an overview of the roadmap[4], with the key highlights of sequencing rationale:

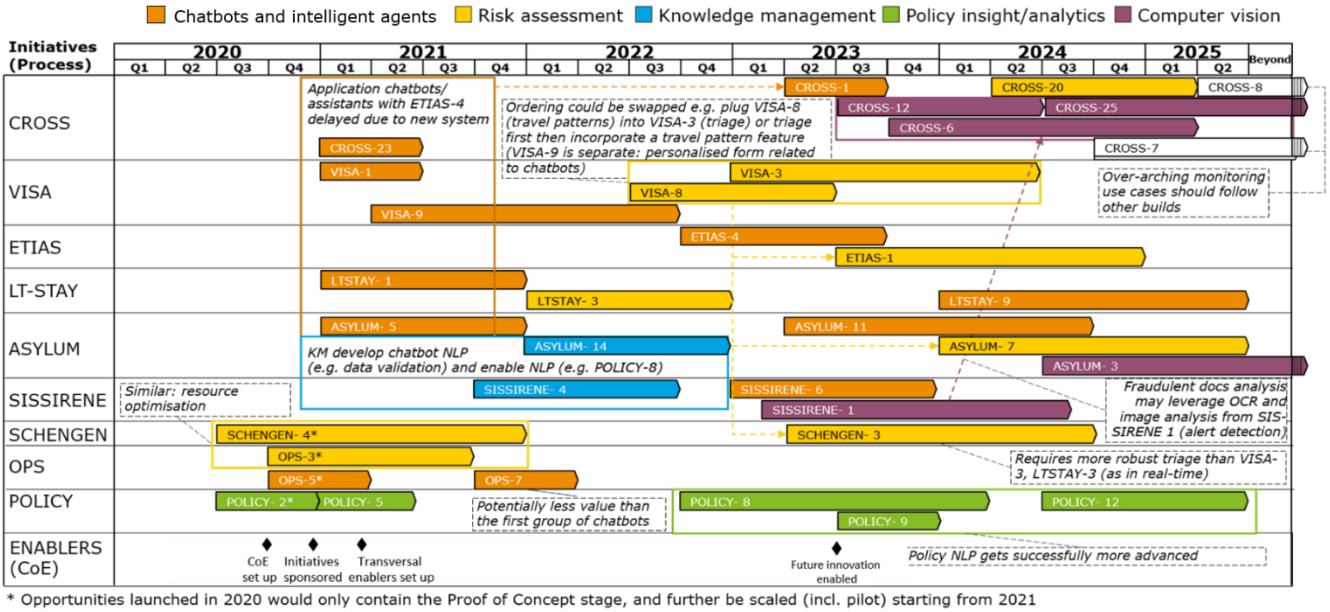

Figure 1: Overview of the roadmap with sequence rational

More feasible opportunities are generally placed to come earlier in the overall sequencing. Most initiatives begin with chatbots, forming a first phase of AI implementation over the coming two years. Some more

[2] Although the roadmap targets the first initiatives to begin in Q3 2020, the overall start date could be adjusted as required (subsequent phasing should remain in its relative ordering but at different/later dates).
[3] "Chatbots" is a more colloquial term generally referring to conversational interfaces while "intelligent agents" implies a broader category tools with additional functionality (such as the ability to personalise). The specific label is not significant in the context of this report, so the term "chatbot" is mainly used throughout as one overarching category.
[4] Regarding the projects in mid-2020, the availability and resources are yet to be confirmed.

complex opportunities, such as risk assessment tools, are also scheduled relatively early due to perceived strategic importance for the European Commission. However, in general, opportunities are sequenced to create incremental increases in complexity.

For example, less intrusive risk assessment opportunities (e.g. irregular travel pattern analytics) are placed before more involved or cross-cutting risk assessment use cases.

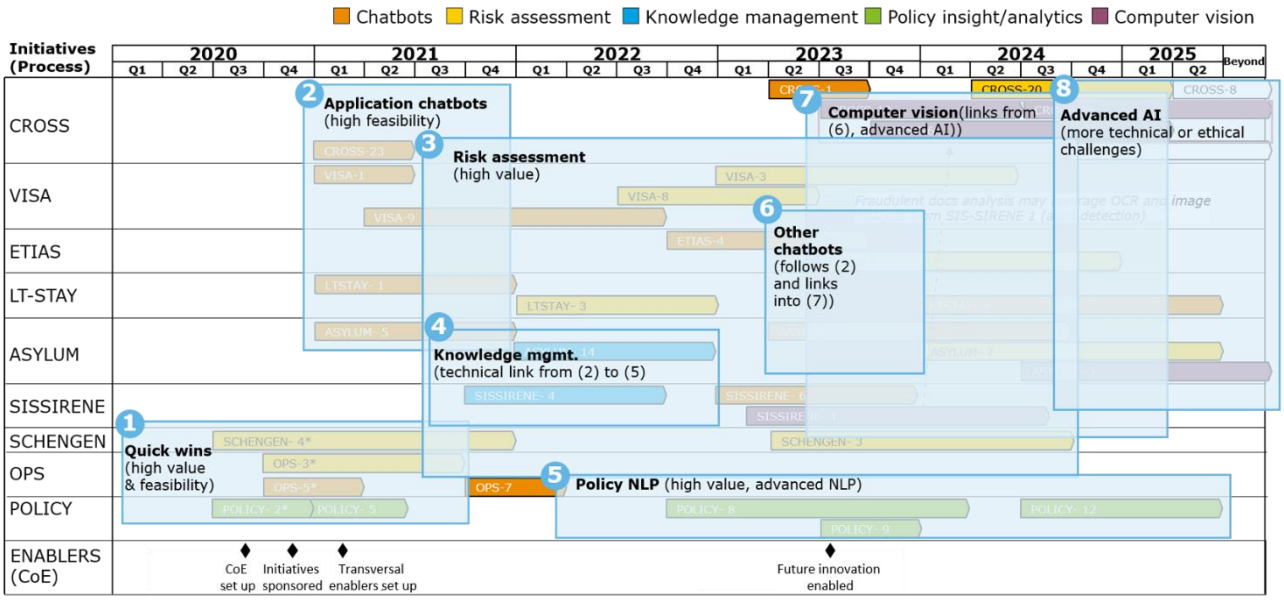

Figure 2: Overview of the roadmap with the different types of opportunities, see Annex A for a larger image

As mentioned, there is an additional stream in the roadmap containing the so-called "enablers". These are activities required for the development of other use cases (e.g. ensuring availability of infrastructure) and to ensure coordination and alignment across initiatives and stakeholders. Six different considerations for this stream are described, namely: Strategy, People, Process, Ethics, Data and Technology. Strategy defines a vision for each of the stakeholders involved and an overall direction for the roadmap. Moreover, DG HOME should articulate a common vision for the use of AI in the borders area. Secondly, the resourcing of people and talent should be centrally coordinated where possible, with local expertise as required, and guided by leadership. The Process dimension highlights the need for a consistent approach to managing different processes and monitoring KPIs. Data enablers advocate for data sharing across opportunities (where relevant) while providing oversight on data privacy and protection. Finally, a common view of technological best practice for development environments, vendor solutions, infrastructure, across different initiatives would help to drive the roadmap forward.

In general, all efforts to implement AI sit underneath the over-arching European AI strategy and coordinated action plan, set out by the European Commission. Therefore, implementation should be viewed as a collaborative endeavour. Stakeholders should avoid siloed implementation where possible, for example by creating shared core AI models for subsequent tailoring to different specifications and contexts. Enabling activities are transversal in nature, so the goal of addressing these is to drive broader collaboration around AI (in addition to enabling this roadmap), for example if subsequent AI studies are undertaken by DG HOME.

In this report, one approach to addressing these enablers is explored, namely to establish a Centre of Excellence (CoE) or "hub". Centres of Excellence are flexible communities of specialists built to address common goals around a topic or technology. By bringing together business and technology stakeholders, CoE's can develop best practices, build use-case solutions, and provide training, and share resources and knowledge to, in this case, increase the chance of a successful implementation programme. It is recommended for DG HOME (and various stakeholders) to perform some further thinking on specific roles and responsibilities to match their needs.

To maximise benefits from the CoE approach, this study recommends it has five distinct responsibilities. Firstly, it would need to facilitate the integration with the border control, security and migration processes and systems: the CoE would act as a "test bed" for member states and EU agencies to trial new processes and technologies driven by AI solutions. Secondly, the CoE would be responsible for designing and setting-up an AI platform with tools to support member state authorities and other agencies to rapidly create AI prototypes and test them within the CoE, ahead of looking to create an MVP or scale the solution in production. Third, the CoE would provide a set of services around AI research, innovation, and guidance/monitoring on some of the enabling dimensions such as regulatory impacts and ethical implications. The CoE could evolve to certify the use of certain technologies for the implementation of AI across the EU, leading to standardisation. Finally, suitable governance of the CoE should be in place: the stakeholders responsible of governing the CoE would be a combination of EU agencies, member states representatives and any relevant industry partners.

This study also provides guidance around how to operationalise these AI opportunities, by means of detailing the different steps required in a typical AI implementation. This typically begins with a Proof-of-Concept to validate the core idea, followed by a more developed Minimum Viable Product (to build and test the other requirements) before a full-scale implementation project to deliver and deploy the solution (comparison against Commission Technology Readiness Levels is provided in the document). The requisite skillsets consist of data science, data engineering, business analysis and project management expertise. Specific considerations are provided for the given technical clusters, and specific AI opportunities where relevant.

In the context of the European Commission, a typical approach to an AI implementation would see central funding and coordination from the Commission or DG HOME. Significant member state (and/or Agency) specifics that are present across a single AI opportunity (for example different member states working with incompatible local systems of some kind) may necessitate local staffing of the more technical resources, especially as the AI implementation progresses in scale. However, as is noted throughout this report, a holistic approach with cross-initiative collaboration would help to drive the roadmap forwards. More details on project resourcing and division of responsibilities across stakeholders in the ecosystem is provided for each AI initiative in section 5.3.

Whilst identifying use cases at the outset of this study (through numerous interviews, workshops, and follow-up discussions), an approach that balanced current needs with future aspirations was followed. The resulting longlist consisted of ideas that spanned: AI for automation and streamlining of processes; AI for better citizen and employee engagement; and AI for deeper insights from the increasing quantities of available data. During the subsequent prioritisation exercise there were two particular factors of note that stand out as important areas for future considerations: the ethical nature of a use case, and the availability of data for use cases. As progress is made against this roadmap, it is worth putting increasing focus on the mechanism by which new use-cases and solutions are monitored for their alignment to these ethical principles – particularly for those concepts where there are a number of entities involved in the development. As demonstrated by the ideas short-listed in this study, there is much value to be captured through more effective use of the data that already exists within systems. A recommendation for the future would be to understand how current data capture across Border Control, Migration, and Security could adapt in order to enable some of the use cases that are currently deemed infeasible.

The roadmap will see significant internal efficiencies and external experience improvements brought in to the processes at the start, followed by augmentations to human decision-making (with knowledge, risk and policy analytics solutions). The roadmap concludes with a set of more advanced and ambitious AI use cases which would show DG HOME and related agencies as highly mature with regards to these new technologies. The overall sequencing of the initiatives aims to help achieve short term value, and in parallel, aims to build capabilities and learnings that better facilitate future endeavours. It will be important to prepare the programme across different 'enabling' aspects such as Strategy, Data, Technology, People and Process to

ensure success. The governance mechanisms discussed in this report, such as the CoE, are seen as key to addressing these surrounding points, to maximise the benefits of each initiative.

The reader should understand that this roadmap should be used as guide to assist with implementing the AI initiatives as defined in this document. In other words, the roadmap is a strategic plan that defines a goal and includes the major steps or milestones needed to reach it. It also serves as a communication tool and a high-level document which articulates strategic logic (the 'why') behind both the goal and the plan. Different external factors might change in the coming months. Therefore, the roadmap must be seen as a toolkit with different elements that can help the organisation in their implementation journey, with the acknowledgement that depicted elements (synergies, dependencies, constraints, etc.) may shift. Considerations for adapting the roadmap in the future might include new technological advances (with AI platforms and academic research becoming ever more mature), new migration trends and projects within the EU, specific member states considerations and needs, and so forth.

The analysis of AI opportunities and development of the implementation roadmap were conducted between September 2019 and February 2020, reflecting the working context (legislation, technology, resources, etc.) as understood during this time. An outbreak of 2019 novel coronavirus (SARS-CoV-2/COVID-19) spread from Wuhan, Hubei Province, China to Europe and other countries around the world during this period. On 11 March 2020, the World Health Organisation recognised the spreading coronavirus disease as a pandemic. At the time of writing this report, the pandemic is ongoing and unprecedented social measures are in effect to contain the spread (including closed borders, social distancing and individual movement lockdown). The consequences of this global crisis on border control and migration, and on priority setting and resource allocation within the EU in future, are currently unknown. The study does not attempt to reflect the impact of the coronavirus pandemic beyond presenting the option of postponing the entire timeline.

This study benefited from many enthusiastic stakeholders in the European Commission ecosystem, willing to explore using AI to improve their day-to-day work. The stakeholders understand that AI has a high potential but should be tackled in a considerate manner, as reflected by the general suggested approach to development. Furthermore, there will be regulatory, political and technological challenges necessary to be overcome. Despite these, DG HOME is excited to harness AI for the benefit of borders, migration and security in Europe.

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1 Introduction

1.1. Context

As stated by the European Commission "Artificial intelligence (AI) refers to systems that display intelligent behaviour by analysing their environment and taking actions with some degree of autonomy to achieve specific goals"[5]. Even though this definition is commonly accepted, the rise of AI in Europe has occurred mainly in a regulatory void where very few legal initiatives were taken in order to regulate AI at a systemic level.

Following a request from several MEPs to propose rules on robotics and AI and due to strong global competition on AI among key players in the US, China and Europe, in October 2017, the European Council urged the European Commission to develop a European approach to AI.

Then, in April 2018, the Commission published a European strategy on Artificial Intelligence[6] that proposed an approach that places people at the centre of the development of AI (human-centric AI) and encouraged the use of this powerful technology to help solve the world's biggest challenges, such as fighting crime and improving cybersecurity. This resulted in an adoption of the Coordinated Action Plan on AI, which intends to maximise the impact of investment at the EU and national levels, encourage cooperation across the EU, exchange best practices, and support the EU's global competitiveness in this sector. This plan should be realised with concrete projects as the basis for capturing the full extent of AI's economic potential while guaranteeing a strong standard of safety and security.

Within the EU, many member states have adopted national AI strategies and since the beginning of 2019 the Commission's Directorate-General for Migration and Home Affairs (DG HOME) started exploring the opportunities for the application of AI in its policy areas and, in particular, in the area of migration, border control and security.

The European Union has experienced significant pressure on its external borders in the last few years. It is likely that there will continue to be high numbers of third-country nationals crossing Schengen borders in future. A study for the European Commission has estimated that the total number of regular crossings will rise to 887 million[7] in 2025, up by more than half in a little more than a decade. Consequently, there is a need to modernise border controls, migration and security processes.

In the beginning of 2019, Directorate General for Migration and Home Affairs (DG HOME) conducted an initial assessment for using AI in its policy domain. The results of this study showed that already several real-life AI applications exist in the area of criminal investigation and law enforcement. However, it was shown that this is quite the contrary for many other areas, such as migration and border control. Therefore, with respect to the latter, DG HOME decided to launch a study to analyse and describe to what extent AI can be leveraged in the context of border control, migration and security. The next subsection expands upon the study objectives.

[5] Source: European Commission, A definition of Artificial Intelligence: min capabilities and scientific disciplines, 2019. Link : https://tinyurl.com/yyq2cp6t
[6] Source: European Commission, Communication from the Commission: AI for Europe {SWD(2018) 137 final}, 2018. Link: https://tinyurl.com/y6787gm3
[7] Source: European Commission, Impact Assessment Report on the establishment of an EU Entry Exit system, SWD(2016) 115 final, 2016. Link: https://ec.europa.eu/transparency/regdoc/?fuseaction=list&coteId=10102&year=2016&number=115

The analysis of AI opportunities and development of the implementation roadmap were conducted between September 2019 and February 2020, reflecting the working context (legislation, technology, resources, etc.) as understood during this time. An outbreak of 2019 novel coronavirus (SARS-CoV-2/COVID-19) spread from Wuhan, Hubei Province, China to Europe and other countries around the world during this period. On 11 March 2020, the World Health Organisation recognised the spreading coronavirus disease as a pandemic. At the time of writing this report, the pandemic is ongoing and unprecedented social measures are in effect to contain the spread (including closed borders, social distancing and individual movement lockdown). The consequences of this global crisis on border control and migration, and on priority setting and resource allocation within the EU in future, are currently unknown. The study does not attempt to reflect the impact of the coronavirus pandemic beyond presenting the option of postponing the entire timeline.

1.2. Objectives of the study

The main objectives of this study are:

- To establish a set of opportunities in the AI for borders, migration and security area
- To detail a portfolio with initiatives to be implemented (from short to mid-term)

This study started by providing an assessment of the current state of research, development and application of AI in the area of borders, migration and security. In the next stage, the study focused on understanding to which extend AI can be applied in border control, migration and security in Europe, identifying and prioritising use case opportunities. Finally, AI opportunities are grouped into coherent initiatives and detailed as a "programme of work", setting out strategic commentary and an implementation roadmap.

1.3. Link to previous analysis ("Opportunities of the use of AI")

1.3.1. Brief recap of the methodology used in this study

This study has been performed using Deloitte's AI Journey framework. This is an end-to-end, step-by-step map which brings organisations from the state of discovering the potential of AI all the way to transforming themselves into an organisation where AI thrives. It has been deployed across a spectrum of public and private sector organisations. The study utilises a series of stages reminiscent of a traditional 'use case prioritisation funnel but designed specifically for dealing with AI technologies – a broad set of possible use cases is created, prioritised and eventually the top use cases are built out in more detail. It should be noted that stages do not have to occur in order, rather there may be iteration between stages. Additionally, adaptations for DG HOME specifically have been incorporated:

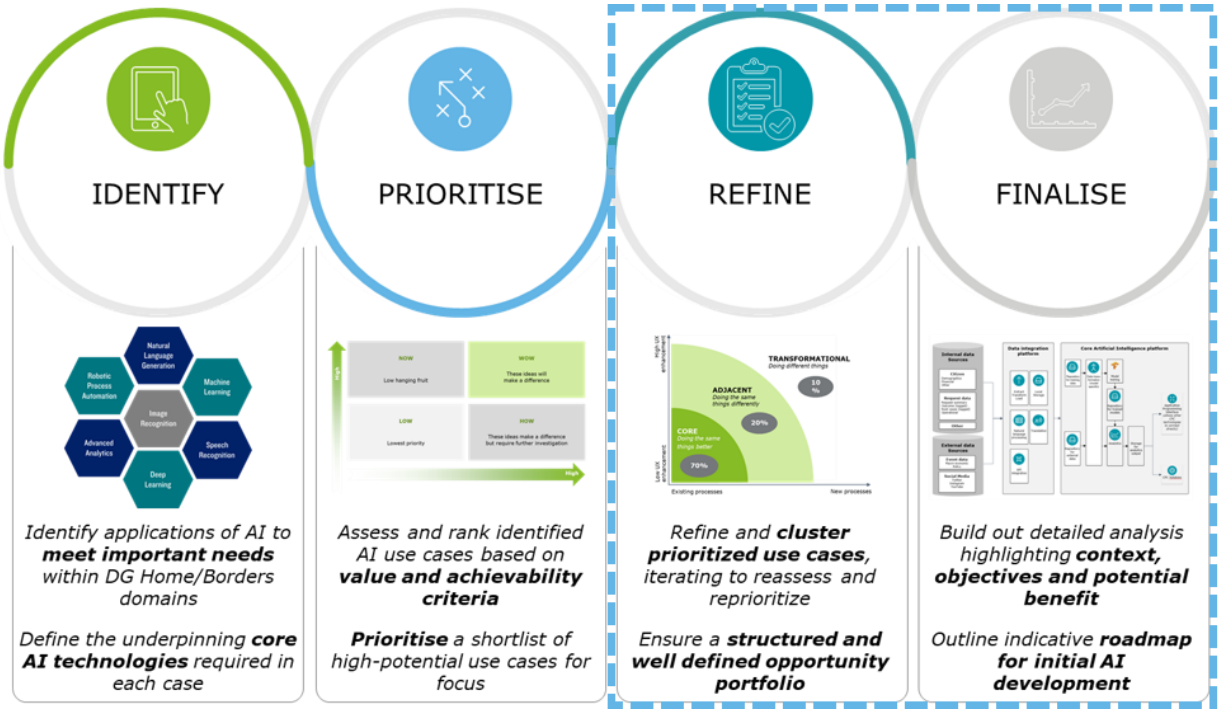


Figure 3: Stages of the analysis framework utilised in this study

For more detail on each stage of the methodology, refer to Annex C.

1.3.2. High-level overview of the results in the first part of the study

This subsection briefly lays out the outcomes of the previous part of the study.

Identify phase

The exercise at this stage was to explore the broad range of possibilities for applying AI technologies to the process areas in scope.

A longlist of approximately 100 AI use cases was developed across all the processes in scope of this study. This was done by means of multiple interviews with process owners discussing their aspirations, current pain points and specific process-led thinking, and leveraging the expertise of AI practitioners. The use cases on this list are distributed evenly between the various processes, and split by AI type and level of aspiration.

Certain processes share similarities in terms of common activities or similar usage of data, giving rise to common pain points. Use cases that address these are described as "cross-process" or "transversal".

Prioritise phase

Following the prioritisation exercise, a shortlist of 35 use cases were identified showing a good level of variety (see Annex B |). While some organisational goals are naturally based on financial improvements or efficiencies, others are directly related to driving improvement in the individual experience of EU citizens and Third-Country nationals (expressed as better provision of information, streamlined or individualised touchpoints). This has meant that some use cases are operational in nature (such as accessing and processing more data sources) while others are more analytical and for 'front line' deployment (such as those use cases which serve as decision support in the domain of risk assessment). Technological aspirations are similarly varied: while the technical designs of use cases have not been fully developed, it is clear that some will lend themselves to more standardised solutions (such as chatbots which can often be procured 'off-the-shelf') while others are in the territory of bespoke and advanced Deep Learning models.

During the analysis, commonality was observed between the opportunities identified and prioritised for the different processes. This resulted in a grouping of use cases that allowed similar transversal conclusions across processes and use cases. These groupings are along a combination of technical and capability axes, designed with the commonality of AI approaches in mind. These opportunity groups are listed below:

- **Ethics -** Use case which directly supports one or more ethical principles as defined by the EU. Moreover, they foster ethical decision-making such as making fair risk assessments;
- **External chatbots -** Chatbots that communicate with civilians;
- **Fraud detection -** Support border guards and case workers in assessing if various documents are genuine or not;
- **General risk assessment -** Risk assessment performed on a group of individuals with the general aim to find patterns and cluster individuals for further investigation;
- **Individual risk assessment -** Assessment on the individual level, to determine eligibility or granting of a certain permit or right;
- **Integration fostering -** Focussed on Third-country nationals who received a permit for a longer stay compared to a temporary travel permit. These use cases aim to support the integration of these 'new' individuals within the European Union;
- **Internal chatbots and intelligent agents –** Solutions used internally within the Agencies and member states to support their day to day tasks[8];
- **Macro environment analysis -** Macro-level assessment to identify possible security risks with the aim to take appropriate action and prevent this risk evolving;
- **Monitoring -** Use of tools to ensure that conditions to enter and remain within the Schengen Area are fully respected over time.

1.4. Purpose and objective of this document

As stated before, the report is the second in the study on "Opportunities of AI in border control, migration and security". It builds upon the previous work done, i.e. the Identify and Prioritise phases.

The analysis performed here takes the inputs from the previous tasks for a two-fold objective:

- To establish a set of opportunities in the AI for borders, migration and security area
- To detail a portfolio with initiatives to be implemented (from short to mid-term)

To address the first objective, similar use cases are grouped together for various reasons such as creating synergies and economies of scale. The second objective looks at a time-dependent aspect, logically sequencing the use cases into a practical implementation roadmap, which is a tool to be used to guide the overall programme with highlights on aspects such as enabling activities (see chapter 6) and the critical path (see 4.3).

1.5. Structure of this document

The document is structured in a top-down manner. First, the reader is presented with the full roadmap, with generic elements explained to familiarise the reader with the roadmap's structure. Later in the report, the analysis zooms in on different aspects of the roadmap, explaining key implementation considerations and the associated rationale for developing the roadmap in such a way.

[8] "Chatbots" generally refer to conversational interfaces while "intelligent agents" imply tools with additional functionality (such as the ability to personalise). The specific label is not significant in the context of this report, so the term "chatbot" is mainly used throughout as one overarching category.

2 Combined roadmap overview

This chapter is to provide the reader with background on how the roadmap should be used by different stakeholders (such as member states, EU agencies and other interested parties). This is followed by an overview of the roadmap, familiarising the reader with the structure.

2.1. Objectives of the roadmap and related considerations

This subsection provides a description on how the roadmap should be read and what types of considerations where taken into account during the analysis.

2.1.1. Objectives: What is a roadmap and how should it be used?

A roadmap is a strategic plan that defines a goal or desired outcome and includes the major steps or milestones needed to reach it. It also serves as a communication tool and a high-level document that helps articulate strategic thinking—the why—behind both the goal and the plan for getting there.

The reader should understand that this roadmap is meant to be used as a tool and a guide to help in implementing AI initiatives that have been defined. In an evolving environment with moving priorities, it is likely that factors impacting the roadmap will change in the coming years after the publication of this report. Therefore, the roadmap must be seen as a toolbox with different elements that can help the organisation in their tailored journey to implement the various AI use cases. While not everything will happen exactly as depicted in the presented roadmap, synergies and dependencies identified here will still be relevant. The roadmap targets the first initiatives to begin in Q3 2020, however the overall start date could be postponed as required (whereby the subsequent phasing should remain in its relative ordering but at later dates).

2.1.2. Considerations: What needs to be taken into account?

When grouping and sequencing the opportunities and initiatives, several considerations were taken into account. While these will be detailed later in this report, the list below provides a comprehensive overview:

- **Technological synergies & re-use:** Investment in specific technologies to implement any of the initiatives means that this investment can be leveraged to expedite the implementation of other similar initiatives. To this extent, technological synergies is an important factor in grouping projects together on the roadmap, such as "chatbot" use cases.
- **Dependencies**: In some cases an opportunity relies on another or on an external factor. A good example is the implementation of ETIAS, the development project of which currently schedules the application to go live at the end of 2022[9]. Thus, some PoC's can be implemented only once the underlying systems are operational (or at least started). Other dependencies could be of technical nature, where for example certain data or infrastructure needs to be available prior to development.
- **Strategic objectives:** The roadmap needs to align with the strategic objectives of the stakeholders involved. The study takes into account DG HOME's mission as reflected in the strategic plan for 2016-2020 and the overall EU strategic agenda for 2019-2024.
- **Regulatory and political factors:** In the communication published by the European Commission, it is stated that "high-risk" AI opportunities have to follow certain guidelines and requirements when

[9] The "go live" date is currently at the end of 2022. The word "currently" should not be understood as doubt on the feasibility of achieving this end date, but rather acknowledges that projects of such magnitude and complexity can sometimes require contingencies.

put into practice[10]. This can be due to several reasons such as regulatory, ethical or technological considerations:

- *Legal requirements* should always be taken into consideration. These requirements cover legislations that directly link to the process (e.g. ETIAS regulation for ETIAS related use cases) and also other relevant regulations such as the General Data Protection Regulation (GDPR) that may impact the process;
- *Ethical frameworks* are useful tools for achieving ethical AI because they create shared understanding of what is meant by the term, and provide guidance for achieving it. Therefore, proposed AI solutions should follow the Ethics Guidelines for Trustworthy AI developed by the EU[11].

- **Project objectives similarities:** Projects that have similar end objectives within a process or across processes can be grouped together to obtain synergies.
- **Technological requirements:** Some opportunities require certain technological requirements (e.g. availability of infrastructure) prior to development.
- **Organisational and technological maturity:** As some opportunities are more complex than others, the responsible organisation/stakeholder will need certain capabilities to build them and this will be a key factor in the sequencing of activities. Furthermore, in some cases the current technology is not yet mature which makes more sense to sequence later in the roadmap.
- **Related developments within the EU**: Within the AI domain, multiple projects and initiatives already underway in Europe. The AI roadmap that is being defined needs to take into consideration existing initiatives and the associated dependencies.

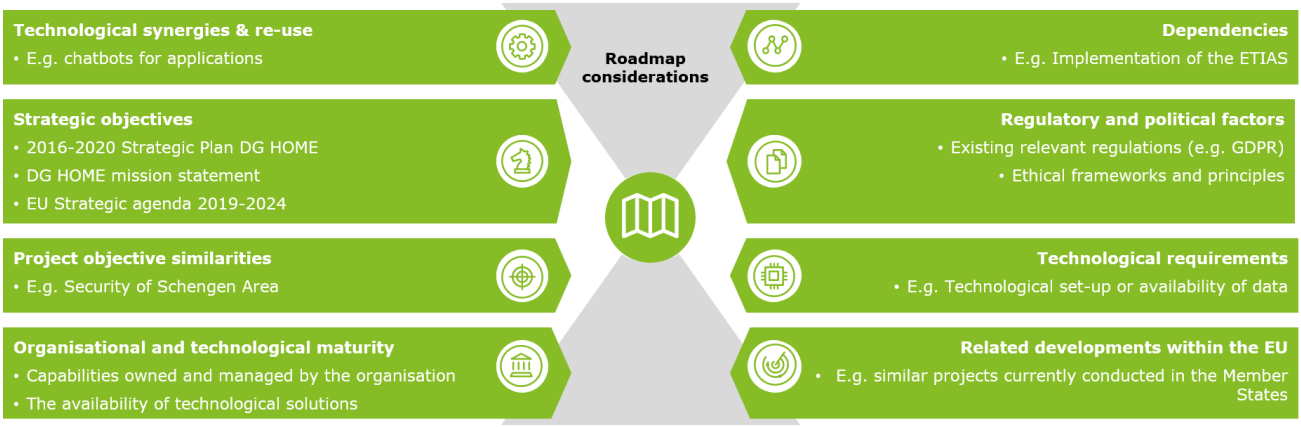


Figure 4: Overview of the different considerations taken into account when developing the roadmap

[10] See section D of COM(2020) 65
[11] Please refer to the previous part of the study or the website of the European Commission (https://ec.europa.eu/digital-single-market/en/news/ethics-guidelines-trustworthy-ai)

2.2. Structure and high-level description of the roadmap

2.2.1. Elements of the roadmap

Before presenting the roadmap, it is important to understand the associated structure and its constituent parts.

First, the timeline is planned over the next five years. This provides a good view on the relatively short and medium term. Implementing and scaling each of the initiatives will in some cases take longer. Looking further would not provide much benefit at this stage due to uncertainties that may develop in the implementation of the individual initiatives.

Secondly, the roadmap consists of different elements, as described below:

- **Opportunities,** different use cases prioritised during the first phase of the study;
- **Initiatives,** groupings of the opportunities due to similarities in objective, scope and relevant stakeholders;
- **Technological clusters,** groupings of opportunities due to similarities in the technology used (e.g. chatbots);
- **Enablers,** activities that are not AI opportunities, but are required to develop and maintain the AI implementations. Moreover, they foster synergies and reuse between the initiatives.

The duration of the implementations of different opportunities vary. This is due to the different complexities related to each opportunity. See chapter 5 for a more detailed discussion on the steps for reaching a full-scale implementation, and the implications of different complexity levels.

Finally, the reader must take in mind that in some cases the timeline is indicative. In other words, because of many reasons the timeline might shift to a later stage. Examples include ongoing discussions with stakeholders regarding funding and the development of specifications, which is key during the procurement. Therefore, during the first year (2020-2021), no pilots or further scaling of AI opportunities will happen. Rather, implementation planned during the first year will focus on developing a Proof-of-Concept and, in parallel, assessing and setting-up enabling elements.

2.2.2. Description of the roadmap

In what follows, the roadmap is presented as a graphic, displaying the expected start and end time for implementation of each of the prioritised opportunities. The full roadmap covers a little more than five years (beginning Q3 2020) to, on the one hand, give a sufficiently long horizon for developing the opportunities; while on the other hand to ensure commitment and capacity for the upcoming activities. The first year is relatively light on AI opportunity development as broader preparations (for funding, procurement, stakeholder engagement) need to happen first. Therefore, only selected Proof-of-Concepts (see section 5.1.2) will happen in the first year along with over-arching enabling activities (known as "enablers", see chapter 6).

On the vertical axis, the nine different initiatives are shown (related to the process areas examined in the first stage of the study), alongside an additional "enablers" stream.

Another element on the roadmap is the five different clusters of opportunities, identified from a technical (and partly business) perspective:

- **Chatbots and intelligent agents**[12] (or virtual assistants) for providing general information and supporting applications and registrations in various contexts (visas, ETIAS, etc.);
- **Risk assessment** and application triaging performed at the point of application and the border itself;
- **Knowledge management (KM)** use cases to facilitate the search and usage of knowledge and data existing in organisation systems or gathered for specific tasks;
- **Policy insight and analytics** to extract novel insights from text data, like linking of similar text (e.g. regulations), knowledge extraction and text summarisation or generation;
- **Computer vision** to gain insights from image processing of individuals (faces, fingerprints, etc.) and objects (vehicle registration plates, etc.).

The figures below provides an overview of the roadmap, with the key highlights of the sequencing rationale (see Annex A for a larger figure).

More feasible opportunities are generally placed early in the overall sequencing. Most initiatives begin with chatbots, forming a first phase of AI implementation over the coming two years. Some more complex opportunities, such as risk assessment tools, are also scheduled relatively early due to the perceived strategic importance for the European Commission. However, in general, opportunities are sequenced to create incremental increases in complexity. For example, less intrusive risk assessment opportunities (e.g. irregular travel pattern analytics) are placed before more involved or cross-cutting risk assessment use cases.

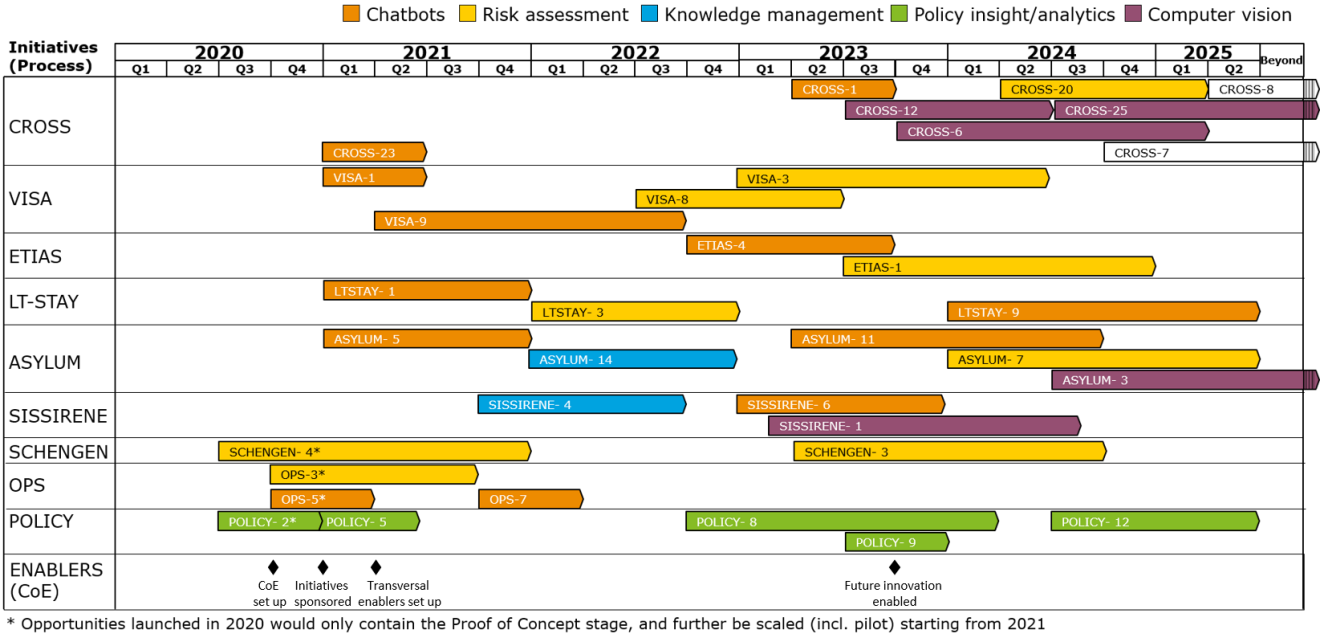


Figure 5: Overview of the proposed roadmap

The sequencing was however not assessed vs resource availability (neither staff nor budget). The roadmap therefore presents an "ideal view" which drives allocation of staff and budget.

[12] "Chatbots" is a more colloquial term generally referring to conversational interfaces while "intelligent agents" implies a broader category tools with additional functionality (such as the ability to personalise). The specific label is not significant in the context of this report, so the term "chatbot" is mainly used throughout as one overarching category.

3 Zoom-in on the initiatives

This section provides a first deep-dive into the roadmap by zooming-in on the initiatives and the opportunities within.

3.1. Relationship between opportunities and initiatives

As stated before, the term "opportunities" refers to prioritised AI use cases (these were identified in Phase 1 of the study). These opportunities are grouped into initiatives for three key reasons:

- Initiatives provide a good way to structure project management across different opportunities;
- Initiatives provide a comprehensive view on the relevant upcoming developments for each stakeholder group (e.g. visa policy officers);
- Grouping into initiatives provides a good way to ensure accountability during and after development, while also ensuring that synergies within the initiative are leveraged.

3.2. Common challenges and risks across the different initiatives

While each initiative poses its own set of challenges and potential risks, in this subsection a set of common challenges and risks are observed. These will apply to each of the initiatives. In some cases, the challenges and risks are tailored to relevant initiatives in following sections.

- **Access to required data**: Regulatory and privacy considerations are key when considering obtaining data for these AI use cases, given that personal data is used in many. Of particular importance are European regulations like GDPR. As stated in the first part of this study, data is crucial to the development of AI systems and a lack of accurate or large volumes of data will drastically impede the performance of these models
- **Regulatory compliance**: Existing regulations on certain processes (e.g. Visa code) and how data is captured and processed (including overarching regulations such as GDPR) should be taken into account throughout the AI system lifecycle (this should conform to current approaches to technology implementations). Moreover, if a significant change is made in the manner of data collection and reasons for usage then they may require additional legal justification before reaching pilot and roll-out stages (see last paragraph of 5.1.3 for further comments on legal basis requirements).
- **Adherence with ethical principles:** Similar to rules around data protection, ethical values and respect for human rights should be observed throughout design, development and ongoing usage of these AI systems. While the solutions would perform essentially the same activities as those currently performed by a human, there should be considerations from an ethics perspective around the potential impact of moving to a technology-driven process (for example, whether it changes the way that an end-user would interact in the process).

Following the challenges, three main risks need to be acknowledged by means of appropriate preventive actions:

- **Inappropriate access to (personal) data:** IT systems pose an inherent risk of inappropriate data access due to malicious or inadvertent data breaches. Therefore, the data (especially personal data) should be appropriately protected (both physically and virtually) by techniques like encryption and secure communication channels.

- **Inaccurate results**: Just as it is expected that human errors will occasionally occur, AI models also sometimes rely on similar "judgement calls", especially in situations where input data is dissimilar from the examples used for model training. This means that, while the quantity of misjudgements can be reduced compared to human assessment, errors may still occur, and these could have significant effects on travellers. For this reason, a "human-in-the-loop" or "second review" will be necessary. Furthermore, if training data is not appropriately processed to remove potential bias, the model might make decisions that are perceived as unethical (e.g. discrimination based on demographic data).
- **Unavailability of AI systems**: As with any IT system, AI systems might occasionally fail. While a visa application does not often require an immediate response, a 'fall-back' solution should nonetheless exist to ensure business continuity.

As mentioned, challenges and risks can in some cases be tailored to the specific initiative and opportunity. Additional elements will be covered in the next sections.

3.3. Initiative 1: Visa issuance for short stay

This first initiative focuses on improving the visa application and issuance process in terms of both swifter visa application process (both for applicants and case workers) as improved consultation and security checks. As explained in the first part of this study, there are three main phases in the visa process: the application, examination and verification phases (at the border). The AI opportunities within this initiative pertain largely to the application and examination phases.

3.3.1. Opportunities involved

From the analysis performed in the previous phase of the study, four opportunities (use cases) from the visa process were prioritised:

Table 1: Brief overview of the selected opportunities in initiative 1

Use case ID	Brief description (see Annex B |for a detailed description)
VISA-1 (Application chatbot)	Chatbot supporting visa application process by (1) taking in information, (2) answer questions posed by the applicant and (3) ensure data quality.
VISA-3 (Application triaging)	Application triaging using individual risk assessment for rapid, more efficient risk analysis.
VISA-8 (Identification of irregular travelling patterns)	Identification of irregular travelling patterns as an additional piece of risk analysis and identify so-called "malafide" travellers.
VISA-9 (Tailored application form)	Use of a personalised application form using AI to tailor questions asked to the applicant creating an augmented application form.

3.3.2. Objective and scope

The objective of this initiative is to streamline the visa application process, both for applicants and for visa (application) workers, from the perspectives of time-taken and ease-of-use (user-friendliness). In addition, there is an aim to strengthen the internal security of the Schengen Area by means of improved background checks performed by migration (visa) officers.

This is in line with DG HOME's strategic plan 2016-2020[13], which mentions elements such as "effective border management" and the "use of IT for smarter borders", to both increase security and create a seamless travel experience for so-called 'bona fide' travellers. Finally, it is also in line with the objective of "a well-managed legal migration and visa policy".

3.3.3. Benefits

It is expected that upon completion of the initiative opportunities, several benefits will be realised. Most notably, the following:

- **Faster risk assessment of TCNs:** This would result in possible shorter waiting times for applicants and reductions in time spent on an application per visa worker. The latter is in fact a cost reduction as less staff will be required per number of applications;
- **Improved risk assessment of TCNs:** Following the strategic objectives of DG HOME, some opportunities within this initiative will ensure that every applicant is thoroughly examined limiting the risk of granting visas to travellers with bad intentions (also called 'mala fide travellers');
- **Improved transparency and consistency in the visa granting process:** By means of harmonising the process and assessment both across different member states as also within, the process is less dependent on the individual case worker of the member state granting the visa;
- **Efficient and easy visa application process:** Using the latest technologies and AI advancements, travellers can enjoy a swift visa application process without interruptions;
- **Less manual tasks required by humans:** By means of automating the process, both applicants and visa workers can spend less time on manual low-value added tasks and focus on priorities (i.e. assessment of an individual traveller posing a higher potential risk).

3.3.4. KPIs and success measures

The following presents a list of key performance indicators (KPIs), which can be used to measure the performance of the initiative. Note that KPIs that are more specific can be defined depending on the specific context or stakeholder (e.g. Member state) involved.

Table 2: KPIs related to initiative 1

Key Performance Indicator (KPI)	Reasoning
Time spent per application by visa case handler	A decrease would indicate that applications can be examined more swiftly, resulting in the ability to assess more visas per officer.
Average lead time for applying for a visa	A decrease would show that applicants get a faster response to their request, resulting in lower waiting times for applicant (and showcasing internal efficiency).
Number of "high-risk" travellers identified	A possible significant increase would indicate that less "high risk" travellers slip through the border without proper background checks.
Satisfaction rate of TCNs using the application process	Increase would show that applicants are satisfied and agree with the 'new' process
Percentage of appeals requested	Decrease would indicate that transparency improved and applicants understand why their application was rejected. This would in turn reduce workload on consulates or migration authorities.

[13] Source: https://ec.europa.eu/info/publications/strategic-plan-2016-2020-migration-and-home-affairs_en

Number of successful appeals (appeals which result in an overturn of the initial decision).	A low number (or percentage decrease) would indicate that the first decision is accurate and there is a low number of flaws in the process.

3.3.5. Notable challenges, considerations and relevant risks

With respect to the opportunities in this initiative, few additional elements can be identified additional to the common challenges and risks defined in 3.2.

- **Access to required (amount of) data**: Specifically for VISA-8 (identification of irregular travelling patterns), the model would also require data to be provided by different airlines, for which there are not necessarily legal obligations in place.
- **Regulatory compliance**: Two opportunities, VISA-3 (application triaging) and VISA-8 (identification of irregular travel patterns) that present an alternative technology for an existing process would not require additional legal basis (at EU-level) before roll-out. However, VISA-1 (application chatbot) or VISA-9 (tailored application form) significantly change the manner of data collection and reasons for usage, which would likely require change in (national) regulation if put fully into practice.
- **Adherence with ethical principles:** Ethical principles should be observed throughout implementation, to prevent occurrences such as inadvertent racial bias coming in to the visa application and granting process.
- **Auditability:** As the AI model will perform the tasks of the visa officer, it should provide a good reasoning for the outcome of the visa application both to the officer and the applicant. The latter is important, as this is mandatory under the GDPR regulation.

Apart from the challenges, a number specific considerations regarding risks need to be acknowledged. Moreover, they require appropriate preventive actions:

- **Inaccurate results**: This is specifically a risk for opportunities VISA-3 (application triaging) and VISA-8 (identification of irregular travelling patterns) because of the potentially significant impact it could have on travellers. This would be mitigated by having a 'human in the loop', because ultimately a human case manager would make the decisions. Nevertheless, inaccurate model outputs (for example false positives) may impede decision making or cause some travellers to be the subject of unnecessary background checks.
- **Unavailability of AI systems**: While a visa request is logically less urgent than an immediate border crossing, business continuity should be ensured to prevent congested pipelines. Hence alternatives should be made available and the opportunities in this initiative should not be a dependency for the visa application process.
- **Visa digitalisation roadmap:** Specially, VISA-3 (application triaging) and VISA-9 (tailored application form) are dependent on the development of a digital visa application process. A delay in the associated Commission project (Digitalisation of visas), could lead to a delay in the implementation of the related AI initiatives. While not fully dependent, the other two use cases, VISA-1 (application chatbot) and VISA-8 (identification of irregular travel patterns) would also benefit from the existence of a digital application process. For example, it would be sensible to integrate the chatbot (VISA-1) in the digital visa process.

3.3.6. Key stakeholders within this initiative

The following entities can be identified as stakeholders in one or more opportunities within this initiative:

- **Visa policy makers,** as part of the overseeing authority facilitating cooperation between member states;
- **Embassies and consulates, or migration authorities** as users of VISA-3 (application triaging) and VISA-8 (travel pattern identification);
- **National authority,** as the approver of changes in the national visa process and the overseeing authority of the visa consulates;
- **Third-country nationals applying for a visa,** as the users of VISA-1 (application chatbot) and VISA-9 (tailored application form), and providers of personal data used in the AI solutions;
- **eu-LISA,** as responsible for operational management of the VIS system.

3.4. Initiative 2: Issuing ETIAS travel authorisation

This second initiative is related to the ETIAS travel authorisation issuance process. The aim is to make the best use of existing technology for maximising the speed of ETIAS applications (both for applicants and case workers) and compliance with security checks. Similar to the visa process, there are three main phases in the ETIAS process: the application, examination and verification phase (which occurs at the border). The AI opportunities within this initiative are focused on the application and examination phases.

3.4.1. Opportunities involved

As explained in the report of phase 1 of the study, two opportunities (use cases) from the ETIAS process were prioritised:

Table 3: Brief overview of the selected opportunities in initiative 2

Use case ID	Brief description (see Annex B |for a detailed description)
ETIAS-1 (Risk assessment)	Individual risk assessment in case of a 'hit' in the first automatic risk assessment, facilitating further review by a member state
ETIAS-4 (Application chatbot)	Virtual assistant supporting the ETIAS application process by (1) taking in information, (2) answer questions from the applicant and (3) ensure data quality

3.4.2. Objective and scope

This objective of this initiative is similar to the first initiative (using AI in the visa process), which is to streamline the application process both for applicants and case workers while also strengthening the internal security (of the Schengen Area) by means of improved background checks. The scope of this initiative is restricted to the ETIAS application and examination phase.

This initiative aligns with the strategic objective of "Effective border management" as communicated by DG HOME in their strategic objectives for 2016-2020[14]. It is also is in line with the objective of having "a well-managed legal migration and visa policy".

[14] Source: https://ec.europa.eu/info/publications/strategic-plan-2016-2020-migration-and-home-affairs_en

3.4.3. Benefits

It is expected that upon implementation of the opportunities, several benefits will be realised. Given the similarities with the first initiative, there are many overlapping benefits. Therefore, only a brief explanation is given here:

- **Swift risk assessments of TCNs** in the cases of a "hit" during the automatic risk assessment performed in the ETIAS process. "Swift" means shorter waiting times for applicants and less time spent on an applicant per case worker, in comparison to the baseline process which relies on more manual decision-making. The latter point would imply a cost reduction with respect to resource time usage;
- **Improved risk assessment of TCNs:** similar to Initiative 1, but here performed in the case of a "hit" during the automatic ETIAS risk assessment. "Improved" means that case workers will be able to spend more time on thorough backgrounds checks (as opposed to spending some of that time searching and looking at data);
- **transparent and consistent ETIAS granting process:** providing support in the individual risk assessment helps to achieve common execution across member states and thus fairer decisions in the sense that they are more data-driven and would mitigate potential outcome variation across different case workers;
- **Efficient and easy application process:** similarly to Initiative 1, i.e. using the latest technologies and AI advancements, travellers can enjoy a swift ETIAS application process without unnecessary interruptions;
- **Fewer repetitive tasks required by humans:** similarly to Initiative 1, i.e. by means of automating the process, both applicants and case workers can spend less time on repetitive manual tasks (e.g. data entry or searching) and focus on higher value tasks (e.g. individual risk assessment).

Please note that for some elements, the presented benefits will only be valid for minority of users of the ETIAS (i.e. individuals flagged as a "hit" in the first, automatic risk assessment).

3.4.4. KPIs and success measures

The following presents a list of key performance indicators (KPIs), which can be used to measure the performance of the initiative. Note that KPIs that are more specific can be defined depending on the specific context or stakeholder (e.g. Member state) involved.

Table 4: KPIs related to initiative 2

Key Performance Indicator (KPI)	Reasoning
Time spent per application by ETIAS officer (central and national unit)	A decrease would indicate that applications can be examined more swiftly, resulting the ability to assess more travel authorisations per individual.
Satisfaction rate of TCNs using the application process	Increase would show that applicants are satisfied and agree with the 'new' process
Percentage of appeals requested (decrease would indicate that transparency improved and applicants understand and agree with why their application was rejected)	Decrease would indicate that transparency improved and applicants understand why their application was refused. This would in turn reduce workload on ETIAS officers.
Number of successful appeals (appeals which result in an overturn of the initial decision)	A low number (or percentage decrease) would indicate that the first decision is accurate and repealing is not because of large flaws in the process.

3.4.5. Notable challenges, considerations and relevant risks

With respect to the opportunities in this initiative, few additional considerations can be identified additional to the common challenges and risks defined in 3.2:

- **Inaccurate results:** under-performing AI systems might lead to ETIAS applications being slowed down or inappropriately granting travel authorisations. To prevent this, similar mitigations as in Initiative 1 should be employed (such as 'human-in-the-loop' to periodically review outputs).
- **ETIAS development timeline:** It should be noted that ETIAS is a planned system not yet in use. Therefore, development of the solutions in this initiative should wait until the system is live (or at least until the specifications of the new ETIAS systems are clear).

3.4.6. Key stakeholders within this initiative

The following entities are expected to be the key stakeholders in one or more opportunities within this initiative:

- **ETIAS central unit,** as a possible user of ETIAS-1 (risk assessment);
- **ETIAS national unit,** as a user of ETIAS-1 (risk assessment);
- **Third-country nationals applying for an ETIAS,** as users of ETIAS-4 (application chatbot) and providers of personal data used in other AI solutions;
- **eu-LISA,** as responsible for operational management of the ETIAS system.

3.5. Initiative 3: Issuance of docs for long-stay or residence in the Schengen Area

The third initiative is related to the issuance of documents for long-term stay or residence in the Schengen Area. The initiative aims to improve the process terms of both swifter applications (both for applicants and case workers) and improved compliance checks. As explained in the report of phase 1 of the study, there are mainly three phases in this process: Application, Examination and Communication. The AI opportunities presented in this initiative aim to add value to all three.

3.5.1. Opportunities involved

As explained in the report of phase 1 of the study, three opportunities from the long-term migration process were prioritised:

Table 5: Brief overview of the selected opportunities in initiative 3

Use case ID	Brief description (see Annex B |for a detailed description)
LTSTAY-1 (Application chatbot)	Virtual assistant supporting long-term stay permit or migration application process
LTSTAY-3 (Application triaging)	Automatic triaging of applications to speed up risk assessments
LTSTAY-9 (Moving within the Schengen area)	Supporting system for moving within the Schengen Zone, speeding up the application process (e.g. through use of a virtual assistant)

3.5.2. Objective and scope

The objective of this initiative is, similarly to Initiatives 1 & 2, to streamline the application process for both applicants and migration officers. For example, decreased waiting times is an expected outcome. Secondly, the goal is to ensure compliance with migration requirements in the Schengen Area by means of appropriate background checks. The initiative scope is restricted to the process of applying for a long-term stay permit or for residence in the Schengen area (i.e. applying for long-stay visas and residence permits). This process involves cooperation between national (member state) and central systems, and cooperation between individual member states.

The initiative objectives are in line with the strategic plan 2016-2020[15] of the DG HOME, which mentions aims such as "effective border management", "a new policy on legal migration to address skill shortages" and "a well-managed legal migration and visa policy".

3.5.3. Benefits

It is expected that upon completion of the initiative opportunities, several benefits will be realised. Most notably, the stakeholders of this initiative can expect the following:

- **Shorter application processing time:** through automation, i.e. LTSTAY-3 (application triaging) and LTSTAY-9 (moving within the Schengen area), and self-service possibilities, i.e. LTSTAY-1 (application chatbot) the application process would happen faster, resulting in shorter waiting times for applicants. Moreover, a larger number of individuals could be processed (and hence receive a permit decision), addressing the strategic priority around effectiveness.
- **Decrease 'manual' work:** not only is automation often faster, it enables case workers to spend more time on tasks requiring more focus, such as applications requiring more detailed evaluation.

3.5.4. KPIs and success measures

The following presents a list of key performance indicators (KPIs), which can be used to measure the performance of the initiative. Note that KPIs that are more specific can be defined depending on the specific context or stakeholder (e.g. Member state) involved.

Table 6: KPIs of initiative 3

Key Performance Indicator (KPI)	Reasoning
Time spent per application by case officer	A decrease would indicate that applications can be examined more swiftly, resulting the ability to assess more applications per individual.
Average lead time per application	A decrease would show that applicants get a faster response to their request, resulting in lower waiting times for individuals (and showcasing internal efficiency).
Increase in number of applications processed per year	Related to the first KPI, this would highlight that assessing eligibility of applications is more efficient than before.
Satisfaction rate of TCNs using the application process	Increase would show that applicants are satisfied and agree with the 'new' process
Percentage of appeals requested	Decrease would indicate that transparency improved and applicants understand why their application was rejected. This would in turn reduce workload on case workers.

[15] Source: https://ec.europa.eu/info/publications/strategic-plan-2016-2020-migration-and-home-affairs_en

Key Performance Indicator (KPI)	Reasoning
Number of successful appeals (appeals which result in an overturn of the initial decision)	A low number (or percentage decrease) would indicate that the first decision is accurate and there is a low number of flaws in the process.

3.5.5. Notable challenges, considerations and relevant risks

With respect to the opportunities in this initiative, few additional considerations can be identified additional to the common challenges and risks defined in 3.2:

- **Access to required data:** LTSTAY-3 (application triaging) and LTSTAY-9 (moving within the Schengen area) require personal (sensitive) data to be able to operate. While the ethical principles should be considered, legal/regulatory requirements should be addressed as well (such as GDPR). Any requisite legislation change would depend on the context of solution developed (e.g. at central or national level) – for example LTSTAY-9 (moving within the Schengen area) will require sharing of personal data between member states. As noted in the last paragraph of 5.1.3, significant alterations to data collection and the purpose of data usage may require EU-level legal basis before pilot and roll-out phases (LTSTAY-9, moving within the Schengen area, in particular).
- **Inaccurate results**: A second difference is in the nature of AI model inaccuracies. These may occur if the quality of training or input data is not sufficient for the complexity of the task. Inaccurate results could have a severe effect on the individual, specifically for opportunities LTSTAY-3 (application triaging) and LTSTAY-9 (moving within the Schengen area). In the former, TCNs might be excessively vetted without them posing a true serious risk. Conversely, high-risk individuals might not be flagged during Examination. Therefore, it will be crucial to have a human providing general oversight on the solution, which should be treated as a supplementary tool for supporting human-led decision-making, rather than a direct substitute.

3.5.6. Key stakeholders within this initiative

The following entities can be identified as stakeholders in one or more opportunities within this initiative:

- **Migration authorities:** as users and approvers of new AI solutions used in the process;
- **Other EU member states:** as parties involved with exchanging TCN information (see LTSTAY-9: moving within the Schengen area);
- **EU consulates:** as parties supporting the application process;
- **Third-country nationals applying for a long-term stay permit,** as users of LTSTAY-1 (application chatbot) and LTSTAY-9 (moving within the Schengen area) but also providers of personal data used in the AI solutions (e.g. LTSTAY-3, application triaging).

3.6. Initiative 4: Granting International protection

This fourth initiative is related to the process of granting an individual international protection. This initiative aims to facilitate and speed up the current process while gathering additional insights. As explained in the previous report, there are three main phases in the application process for granting international protection: Application, Examination and Communication. The AI opportunities within this initiative cover each phase, including post-application where the beneficiary of international protection is integrating into their destination.

3.6.1. Opportunities involved

As explained in the report of phase 1 of the study, five opportunities from this process were prioritised:

Table 7: Brief overview of the selected opportunities in initiative 4

Use case ID	Brief description (see Annex B |for a detailed description)
ASYLUM-3 (Vulnerability assessment)	Sensory analysis of individual to analyse if the person should be further investigated by a human social worker or granted special procedural guarantees
ASYLUM-5 (Registration chatbot)	Use of an AI chatbot which facilitates the registering process by going through the steps which do not require human expertise
ASYLUM-7 (Abscondment risk assessment)	AI model to predict risk of an applicant absconding during review of application and the return process (e.g. using variables such as country of origin, previous application history, age)
ASYLUM-11 (Refugee allocation	AI to allocate refugees to geographic regions (at regional level within countries) where they are more likely to find work and integrate smoothly
ASYLUM-14 (Intelligence search engine)	Intelligent search engine to assist with risk assessment of returns to origin country by locating documents, reports, other evidence

3.6.2. Objective and scope

The objective of this initiative is to build a more data-driven approach for applications regarding international protection. Using data and algorithmic analysis to support decision-making presents an opportunity for process transparency. The increased efficiency of an AI approach, coupled with AI opportunities targeted at crucial and sensitive decision points, can then ensure that decision-making is appropriate from both operational and human perspectives. Additionally, the aim is to provide ability for close monitoring of individuals (where justified, e.g. if they are under review) to mitigate absconsion. The scope includes the process for granting asylum and other designations of international protection.

These objectives are in line with the strategic plan 2016-2020[16] of DG HOME, which mentions elements such as "effective border management" which contains elements such as security of the external borders. Moreover, the plan mentions efforts to reduce incentives for irregular migration: to address the "root cause of irregular migration", "fight against smugglers and traffickers" and implement "effective return policies". This initiative would indirectly support all of these aspects of DG HOME.

3.6.3. Benefits

It is expected that upon completion of the initiative opportunities, several benefits will be realised. Most notably, the stakeholders of this initiative can expect the following, whether or not linked to their activities:

- **Faster vulnerability assessment:** this would result in possible shorter waiting times for seekers of international protection due to less time needed per application. This also implies a cost reduction around resource time usage. Faster processing may also mean that compassionate

[16] Source: https://ec.europa.eu/info/publications/strategic-plan-2016-2020-migration-and-home-affairs_en

aspects of the process (such as special procedural guarantees for those deemed as vulnerable) can be provided in a more timely manner.

- **Improved risk assessment of TCNs:** in line with the strategic objectives of DG HOME, some opportunities within this initiative will aim to support the examination of applicants, limiting the risk of granting international protection to individuals who are ineligible or have bad intentions (so-called "mala fide" travellers).
- **More transparent and consistent asylum seeking process:** by harmonising the process and assessment both across and within member states, the process becomes less dependent on the individual case officer taking the decision (and hence mitigates against the chance of outcome divergence due to potential variation across case officers).
- **Less manual tasks required by humans:** similarly to Initiatives 1 & 2, i.e. by means of automating the process, both applicants and case workers can spend less time on repetitive manual tasks (e.g. data entry or searching) and focus on higher value tasks (e.g. individual risk assessment).

3.6.4. KPIs and success measures

The following presents a list of key performance indicators (KPIs), which can be used to measure the performance of the initiative. Note that KPIs that are more specific can be defined depending on the specific context or stakeholder (e.g. Member state) involved.

Table 8: KPIs related to initiative 4

Key Performance Indicator (KPI)	Reasoning
Time spent per application by case officer	A decrease would indicate that applications can be examined more swiftly, resulting the ability to assess more applications per officer.
Average lead time per application	A decrease would show that applicants get a faster response to their request, resulting in lower waiting times for individuals (and showcasing internal efficiency).
Number of vulnerable individuals identified	Levels relatively aligned to existing numbers would indicate that the new systems in place support the applications and case workers in providing the right care to those in need. However, it is acknowledged that there is little quantitative data around vulnerability[17]. An alternative performance signal could be derived from post-hoc reports such as the Key Fundamental Rights Concerns bulletins produced by the EU Agency for Fundamental Rights (FRA)[18].
Decrease in the number of absconded individuals	A decrease would indicate that the solutions for preventing absconsion have a positive effect.

3.6.5. Notable challenges, considerations and relevant risks

With respect to the opportunities in this initiative, few additional considerations can be identified additional to the common challenges and risks defined in 3.2:

- **Inaccurate results**: With regards to opportunities ASYLUM-3 (vulnerability assessment), ASYLUM-7 (abscondment risk assessment) it is important to have a "human-in-the-loop" to

[17] Population Europe: Policy Brief January 2019 (https://population-europe.eu/file/population-policy-compact-202019)
[18] FRA: Migration: Key fundamental rights concerns - Quarterly bulletin 1 - 2020 (https://fra.europa.eu/en/publication/2020/migration-key-fundamental-rights-concerns-quarterly-bulletin-1-2020)

ensure any anomalies or inaccuracies are addressed in a timely manner. This is important because of the large potential impact of model inaccuracies on the individual, such as leading to incorrect decisions from vulnerability assessments or regarding placement into a detention centre.

- **Regulatory compliance**: As noted in the last paragraph of 5.1.3, significant alterations to data collection and the purpose of data usage may require EU-level legal basis before pilot and roll-out phases. In this initiative, this may be most applicable to use cases ASYLUM-3 (vulnerability assessment), ASYLUM-7 (abscondment risk assessment) and ASYLUM-11 (refugee allocation).

- **Difficult to measure:** Additionally, a challenge related to ASYLUM-11 (refugee allocation) is that success metrics would need measurement on a long-term horizon (approximately 5-10 years), making analysis and evaluation difficult. There is also no one clear evaluation metric, since integration concerns complicated phenomena: the social, economic, cultural and political roles played by migrants in a given society, over time. However, example proxy metrics could include measures of acquisition of language skills and continuation of receiving state benefits. The interpretation of these measures would require very careful analysis[19].

3.6.6. Key stakeholders within this initiative

The following entities can be identified as stakeholders in one or more opportunities within this initiative:

- **Asylum seekers and individuals seeking international protection,** as the users of AI solutions (ASYLUM-5, registration chatbot) and providing source of data used;
- **Asylum and migration case worker(s),** as users of ASYLUM-11 (refugee allocation), ASYULM-14 (intelligent search engine), ASYLUM-3 (vulnerability assessment) and ASYLUM-7 (abscondment risk assessment);
- **Migration office(s),** as the approver of changes in the visa process and overseeing authority of the visa consulates;
- **The European Asylum Support Office (EASO),** acting to increase cooperation between and support member states, and improve the implementation of the Common European Asylum System;
- **Local employment authorities**, involved in providing information and receiving migrants as part of ASYLUM-11 (refugee allocation).

3.7. Initiative 5: Consultation of SIS and involvement of the SIRENE Bureaux

This fifth initiative is related to optimising the SIS consultations process and collaboration across the SIRENE bureaux network by means of AI. This initiative covers the tasks of searching/consulting and entering alerts into the SIS database. The goal is to improve the use of the SIS, by means of better usage of the existing processes and data.

3.7.1. Opportunities involved

As explained in the report of phase 1 of the study, three opportunities from the SIS process were prioritised:

[19] Council of Europe – Measurement and indicators of integration (https://www.coe.int/t/dg3/migration/archives/documentation/Series_Community_Relations/Measurement_indicators_integration_en.pdf)

Table 9: Brief overview of the selected opportunities in initiative 5

Use case ID	Brief description (see Annex B |for a detailed description)
SISSIRENE-1 (Alert detection)	Computer vision to detect SIS alerts using cameras
SISSIRENE-4 (Knowledge search/management tools)	An AI tool to aid in the knowledge management of SIS
SISSIRENE-6 (Automatic form completion)	Automatically fill in SIRENE forms

3.7.2. Objective and scope

The objective of this initiative is to make better use of data stored in the SIS system, and to facilitate making new entries into the system while ensuring data quality. The scope encompasses the processes triggered by the consultation of the SIS and parts of the involvement of the network of SIRENE Bureaux.

This objective is supporting specific objective 2.2 (to disrupt organised crime) of DG HOME's strategic plan for 2016-2020[20], which is measured by means of the use of EU information exchange mechanisms (which include the SIS).

3.7.3. Benefits

It is expected that upon completion of the initiative opportunities, several benefits will be realised. Most notably, the stakeholders of this initiative can expect the following, whether or not linked to their activities:

- **More alerts solved:** by increasing the number and the quality of SIS alerts, more alerts can be solved in absolute terms. Moreover, automation of certain checks can ensure a better coverage of alerts, because the process would become more proactive in nature.
- **Less manual tasks required by humans:** by means of automating the process, less time can be spent on manual low-value adding tasks more on tasks requiring human effort such as filling in SIS forms and responding to alerts. Also, due to better quality of the data input into SIS, less time would be spent dealing with data inaccuracies. These efficiency improvements should combine with the higher volume mentioned in the previous benefit point to mean that the overall process is more performant (as opposed being burdened by an increased volume, for example).

3.7.4. KPIs and success measures

The following presents a list of key performance indicators (KPIs), which can be used to measure the performance of the initiative. Note that more specific KPIs that can be defined depending on the specific context or stakeholder (e.g. Member state) involved.

[20] Source: https://ec.europa.eu/info/publications/strategic-plan-2016-2020-migration-and-home-affairs_en

Table 10: KPIs initiative 5

Key Performance Indicator (KPI)	Reasoning
Number of alerts solved	This relates to the overall business objective of the SIS: tracing of individuals, items, cars, etc.
Specific data quality indicators in the SIS (e.g. use of correct SIS forms)	Improve data quality ensures that proper identification can take place without missing or wrong information (which could result in loss of effort)
Number of "mismatched" alerts due to poor data quality or human error	Mismatching of alerts with individuals and items obviously needs to be avoided by all cost. A low number (or decrease) would indicate the systems in place are accurate.

3.7.5. Notable challenges, considerations and relevant risks

With respect to the opportunities in this initiative, few additional considerations can be identified additional to the common challenges and risks defined in 3.2:

- **Access to required data**: With regard to SISSIRENE-1 (alert detection), the model would require data provided by different stakeholders. Moreover, this might not necessarily be covered by existing legal obligations between the European institutions and/or member states.
- **Regulatory compliance**: Most of the solutions in this initiative are not covered by an existing legal basis. Therefore, certain features in SISSIRENE-1 (alert detection) in particular (such as applying facial recognition to video images from public places) will require new regulations or modifications to existing regulations or the way they are implemented (e.g. specific implementing acts) at least when the opportunity is deployed at scale.
- **Adherence with ethical principles:** Here specifically SISSIRENE-1 (alert detection) is at risk of violation of a number of ethical principles, specifically privacy and data governance given the use of sensitive data. Moreover, ethical bias might arise heavily impacting citizen lives.
- **Inaccurate results**: Related to the previous challenge, inaccurate results is big risk for each of the identified opportunities. Specifically for opportunities SISSIRENE-1 (alert detection) and SISSIRENE-6 (automatic form completion), where individuals and citizens might otherwise be the subject of an unjustified police check.

3.7.6. Key stakeholders within this initiative

The following entities can be identified as stakeholders in one or more opportunities within this initiative:

- **member states,** as users of the AI solutions both for filling in SIRENE forms and also responding to alerts;
- **SIRENE Bureaux,** as responsible for overseeing efficient exchange of any supplementary information and coordination of activities connected to SIS alert;
- **eu-LISA,** as responsible for the operational management of the SIS;
- **DG HOME,** as the supporting policy authority providing regulatory and process expertise.

3.8. Initiative 6: Border checks at the external Schengen borders

This sixth initiative is related to the border checks which occur at the external Schengen borders and focuses on how AI can improve the current processes in place in that context. The initiative aims to improve swift border crossings while at the same time improving security of the current border crossing points.

3.8.1. Opportunities involved

As explained in the report of phase 1 of the study, two opportunities from the border check process were prioritised. There are summarised in the table below:

Table 11: Brief overview of the selected opportunities in initiative 6

Use case ID	Brief description (see Annex B |for a detailed description)
SCHENGEN-3 (Triaging border crossings)	AI to triage border crossers
SCHENGEN-4 (Border flow analytics)	Leverage machine learning for operational resource planning

3.8.2. Objective and scope

The initiative focuses on the border checks process at the external Schengen borders. The ultimate objective is to improve and ensure seamless and secure border crossings into the European Schengen Area. This is in line with the strategic plan 2016-2020[21] of DG HOME, which mentions elements such as "Effective border management" and contains elements such as security of the external borders and the use of IT for smarter border (supporting a seamless travel experience for so-called "bona fide" travellers).

3.8.3. Benefits

It is expected that upon completion of the initiative opportunities, several benefits will be realised.

- **Faster processing of travellers:** the flow of travellers will be improved at border crossing point by establishing technological efficiencies and reducing waiting times.
- **Improved risk assessment:** the security of the border will be enhanced by the use of AI to support risk assessment and decrease the dependence on the individual border guard (to mitigate against potential variation between individual border guards). The use of AI should also ensure consistency in the selection of travellers being called for the second line border check by using a data-driven decision process.
- **Better resource management:** expected by increasing the operational efficiency of the border resources allocation. A staffing mechanism that balances the risk of under- (capacity and hence security risk) or overstaffing (increased cost) is aligned to this concept of intelligent and efficient operations.

3.8.4. KPIs and success measures

To ensure that the initiative is reaching its initial objectives, a number of KPIs and success measures are identified. These will be used to assess the impact of the opportunities present within the initiative. These KPIs are as follows:

[21] Source: https://ec.europa.eu/info/publications/strategic-plan-2016-2020-migration-and-home-affairs_en

Table 12: KPIs for initiative 6

Key Performance Indicator (KPI)	Reasoning
Waiting time for travellers	A decrease would show that applicants get a faster response to their request, resulting in lower waiting times for travellers (and showcasing internal efficiency).
Number of "high-risk" travellers identified	A possible significant increase would indicate that less "high risk" travellers slip through the border without proper background checks.
Satisfaction rate of the TCNs crossing the border	Expect this to increase by having a better border crossing flow and less wait times.

3.8.5. Notable challenges, considerations and relevant risks

With respect to the opportunities in this initiative, few additional considerations can be identified additional to the common challenges and risks defined in 3.2:

- **Access to required data**: Regulatory and privacy considerations are key when considering obtaining data for these AI use cases. In case of SCHENGEN-4 (border flow analytics), anonymised (non-sensitive) data would be sufficient to run the solution, hence the risk is rather low. However, in case of Schengen-3 (triage border crossings), the model cannot be used without personal data of the traveller. Nonetheless, it is mandatory for the traveller to provide this information when at a border crossing point.
- **Regulatory compliance**: Concerning SCHENGEN-3 (triage border crossings), a legislative body (central or national) will most likely be required as the opportunity implies a modification to the current process.
- **Adherence with ethical principles:** With regard to SCHENGEN-3 (triage border crossings) should be developed such that the system is free of unethical bias (e.g. against a certain gender or demographic group).
- **Inaccurate results**: Specifically for opportunity SCHENGEN-3 (triage border crossings) a "human-in-the-loop" or "second review" is advised. As inaccurate results will affect travellers in terms of unjustified background checks (i.e. extreme vetting).

3.8.6. Key stakeholders within this initiative

Three main entities are identified as stakeholders in one or more opportunities within this initiative:

- **Border guards at the Schengen border,** as users of the systems;
- **member states,** in charge of approving, developing and managing the AI solution;
- **Third-country nationals** crossing the border**,** as implicit users of the systems and providers of personal data used in the AI solutions.

3.9. Initiative 7: Operational management of services at eu-LISA

This seventh initiative is focused on supporting activities related to the European Union Agency for the Operational Management of Large-Scale IT Systems in the Area of Freedom, Security and Justice (eu-LISA). In practice, it refers to improving the availability of large-scale European IT systems. These systems are currently SIS, VIS and EURODAC. In the near future this will also include EES, ETIAS, ECRIS-TCN and the

Interoperability components. The aim of this initiative is to support the agency in achieving its strategic objectives and its legal obligations.

3.9.1. Opportunities involved

As explained in the first part for the study, three opportunities within the eu-LISA processes were prioritised. Those are summarised in the table below.

Table 13: Brief overview of the selected opportunities in initiative 7

Use case ID	Brief description (see Annex B |for a detailed description)
OPS-3 (Incident prediction)	Big data analytics and metrics to predict failures in the systems and/or incidents with the aim of addressing them before they actually happen or resolve them quickly.
OPS-5 (Triaging chatbot for L1/L2)	Virtual assistant and triaging algorithm to increase efficiency for first- and second-line service desks
OPS-7 (Learning chatbot)	Virtual assistant to support stakeholders in using 'new' systems

3.9.2. Objective and scope

The objective of this initiative is to assist with ensuring that IT services are available with 24/7 uptime while reducing the operational constraints posed by manual tasks. These AI opportunities should help eu-LISA to use its resources in an optimal fashion.

The objective supports the strategic goals defined in eu-LISA strategy document for 2018-2022[22]. Namely the first two objectives, "Continue to grow as a contributor to and implementing partner for the relevant policies in the EU" and "Maintain and extend the role of the Agency as an EU ICT centre of excellence and service provider". Achieving these objectives is only possible when the quality of the services are optimal and the organisation is able to act efficiently and responsively. This point is also addressed in the fourth strategic objective: "Continue to develop an efficient and agile organisation in compliance with the EU regulatory framework".

3.9.3. KPIs and success measures

The following table presents a list of key performance indicators (KPIs), which can be used to measure the performance of the initiative. Note that KPIs that are more specific can be defined depending on the specific context or stakeholder (i.e. preference of eu-LISA) involved.

Table 14: KPIs related to initiative 7

Key Performance Indicator (KPI)	Reasoning
Number of system incidents detected early	An increase would show that eu-LISA can more timely address events to prevent system unavailability
Knowledge base consumption statistics (number of users and/or amount of searching)	Statistics related to consumption of the knowledge bases associated with new systems will demonstrate efficacy of OPS-7 (learning chatbot), which is designed to facilitate access to this knowledge, where benefit is gained if more users are accessing information in a

[22] Source: https://www.eulisa.europa.eu/Publications/Corporate/eu-LISA%20Strategy%202018-2022.pdf

Key Performance Indicator (KPI)	Reasoning
	more efficient way (a simple example would be if the overall volume of searching for information decreased).
User satisfaction measures related to the learning experience	An increase in scores (e.g. from surveys) relative to the previous baseline would indicate that users prefer the learning process enabled by OPS-7 (learning chatbot).
Burden on human resources (trainers)	A reduction in burden (e.g. related to time required to deliver training or to the number of additional questions which a trainer might receive) would imply that the learning process enabled by OPS-7 (learning chatbot) is effective at delivering the learning.
Response time metrics (Mean Time Before Failure and/or Mean Time To Repair)	A decrease in these metrics would indicate improved system fault detection and maintenance response, respectively (from OPS-3, incident prediction)
L1/L2 service desk ticket resolution time	A decrease in time-taken and/or hand-off metrics would show OPS-5 (triaging chatbot for L1/L2) creating process efficiency.
User satisfaction measures related to the service desk	An increase in scores would indicate more nuanced business value of OPS-5 (triaging chatbot for L1/L2), for example showing that users did not mind interacting with a chatbot as opposed to a human.

3.9.4. Notable challenges, considerations and relevant risks

With respect to the opportunities in this initiative, few additional considerations can be identified in addition to the common challenges and risks defined in 3.2:

- **Access to required data:** the AI systems deployed in OPS-5 (triaging chatbot for L1/L2), and (especially) OPS-3 (incident prediction) will require operational data and other data logs, potentially in a low latency stream (i.e. near real-time). While this data is not personally identifiable, obtaining and using it in practice may pose an operational or technical challenge.
- **Inaccurate results**: While the quantity of misjudgements can be reduced compared to human assessment, errors may still occur, and these could have significant effects on systems and uptime, especially for OPS-3 (incident prediction) and OPS-5 (triaging chatbot for L1/L2), in this initiative. To mitigate this, operational guardrails (such as 'human-in-the-loop' or existing ITSM processes) should remain in place. This is necessary due to possible negative impacts on eu-LISA's key priority: keeping the systems available 24/7. As an example, in the case of misclassification of high-impact incidents, this might be looked over by administrators and cause unavailability of the systems.

3.9.5. Key stakeholders within this initiative

The following entities can be identified as stakeholders in one or more opportunities within this initiative:

- **eu-LISA,** as the agency responsible for managing the systems and also user of the AI solutions
- **member states**, as (indirect) users of the systems and AI solutions

3.10. Initiative 8: EU policy making and enforcement process

This eighth initiative, EU policy making and enforcement, is addressing the process of formulating and elaborating the European-level policies that determine legislation. Additionally it addresses the need for ensuring that member states have appropriately enacted directives into their national legislation. This initiative aims to support the policy making process by means of effective policies and faster policy cycles.

3.10.1. Opportunities involved

As explained in the report of phase 1 of the study, five opportunities from the policy making and enforcement process were prioritised:

Table 15: Brief overview of the selected opportunities in initiative 8

Use case ID	Brief description (see Annex B |for a detailed description)
POLICY-2 (Linking regulations)	Linking of related regulations
POLICY-5 (Clustering regulations	Clustering of similar regulations with the benefit of identifying to what extent a directive is transposed into national legislation by member states
POLICY-8 (Automated newsgathering)	Automated newsgathering for new trends from public and internal documents
POLICY-9 (Effective stakeholder communication)	Effective and simplified stakeholder communication
POLICY-12 (Predicting policy acceptance)	Prediction of stakeholder perception and acceptance on a new policy

3.10.2. Objective and scope

The objective of this initiative is to ensure that policy making is effective in the sense that it meets the intended goals and needs. Moreover, the objective is also to facilitate the process of investigating transpositions of EU law to national law.

The scope consists of the policy making and enforcement processes falling under the Directorate-General remit, comprising analysis of factual material, policy measure and legislation proposals and checking the national enactment or application of legislation. AI creates opportunities for optimising specific aspects of the policy making and enforcement process.

Policy making is at the core of any Directorate-General of the Commission. The strategic plan 2016-2020[23] of DG HOME contains further examples of objectives related to policy making, such as "foster[ing] the civic engagement of citizens, to promote values such as tolerance, solidarity and non-discrimination and [encouraging] citizens to play a stronger role in the development of the EU through projects and activities" and the general objective of moving "Towards a New Policy on Migration".

[23] Source: https://ec.europa.eu/info/publications/strategic-plan-2016-2020-migration-and-home-affairs_en

3.10.3. Benefits

It is expected that upon completion of the initiative, several benefits will be realised. Most notably, the stakeholders of this initiative can expect the following, whether or not linked to their activities:

- **Faster policy making** by using supporting tools policy officers can conduct requirements analysis quickly and accurately. Furthermore, as explained in the next point, insights provided by AI, such as predictive analytics as in POLICY-12 (predicting policy acceptance), might create process efficiency by ensuring that policy design is anticipative of policy negotiation positions. This would also lead to faster policy making. However, it is acknowledged that the time taken by policy officers is much less than the time required for negotiations and decision-making, and that expected benefits in the latter case are less certain.
- **Alignment with stakeholder needs:** using automated and data-driven tools, policy development can incorporate new information and feedback quickly and effectively, maximising the chance of legislation acceptance, enactment and value.
- **Less manual work:** when automating information gathering tasks, policy officers can focus on tasks requiring more human effort i.e. the synthesis of and consultation on policy measures, as opposed to data gathering (for example). As in the first point, it is acknowledged that the time taken here is much less than that during the negotiations and decision-making parts of the overall policy making process.

3.10.4. KPIs and success measures

To ensure that the initiative is reaching its initial objectives, a number of KPIs and success measures are identified. These can be used to assess the impact of the opportunities present within the initiative. These KPIs are as follows:

Table 16: KPIs related to initiative 8

Key Performance Indicator (KPI)	Reasoning
Average time between the decision to issue a policy document and its adoption by the Commission	A decrease in time taken would show that the process has become more efficient, with swift communications between stakeholders.
Average number of iterations required during the policy design process	A decrease would indicate increased effectiveness of the policy design process (for example if drafted policy more pertinently addresses concerns and needs of the relevant stakeholders when it is informed by AI such as POLICY-8, automated newsgathering).
KPIs associated with the implemented policy (to monitor long-term effectiveness)	These would be specific KPIs intended to measure how well the policy addresses its identified purpose. These would naturally be dependent upon the specific policy context and might only be expected to provide a high-level sense of policy making effectiveness.
Identification of member state policy misalignment	An increase in identified misalignment (for example where member states have not properly transposed or updated their national legislation) would indicate that a tool like POLICY-2 (linking regulations) or POLICY-5 (clustering regulations) is functioning. A decrease in this KPI over time would show improvement in compliance.

3.10.5. Notable challenges, considerations and relevant risks

With respect to the opportunities in this initiative, few additional considerations can be identified in addition to the common challenges and risks defined in 3.2:

- **Access to required data**: Specifically for POLICY-12 (predicting policy acceptance), the model would require a sufficiently diverse set of inputs to ensure that its outputs are representative of a wide population and mitigate bias. Accessing this data may need to balance against limitations inherent to a tool like POLICY-8 (automated newsgathering), where external data source API terms and conditions may pose limits on the quantity and richness of data able to be gathered.

Following the challenges, a number of risks can be identified. In addition, there are some process-specific risks:

- **Inaccurate results**: Specifically for opportunity POLICY-12 (predicting policy acceptance) and POLICY-9 (effective stakeholder communication), a "human-in-the-loop" or "second review" will be necessary. This is because decisions with significant impact on EU citizens might be taken. Moreover, wrong communications might be shared to the public, which would have a negative effect on the overall image of the organisation.
- **Unanticipated increase in volume of drafted policy:** opportunities in this initiative are designed to increase the speed and efficiency of the policy making process. Therefore, there is a chance that downstream agencies may experience the knock-on effect of a larger volume of drafted policy and related initiatives to address. However, this is not seen as a significant risk as policy initiatives are undertaken after appropriate consideration.
- **Misuse or exploitation of data-driven techniques:** various limitations of AI and data-driven approaches have been identified as part of this study, including algorithmic bias. In this initiative, particular risks include that of confirmation bias (where public opinion appears skewed towards those who are most vocal) and even algorithmic exploitation to intentionally bias analysis with misinformation.

3.10.6. Key stakeholders within this initiative

The following entities can be identified as stakeholders in one or more opportunities within this initiative:

- **DG HOME policy makers,** as users of the AI systems;
- **TCNs, EU Citizens, EU institutions and private companies** as the main stakeholders affected by newly created policies.

3.11. Initiative 9: Transversal process and stakeholder opportunities

This initiative covers opportunities, which do not fit exclusively in one specific process group (and thus initiative). It has various elements that can work across, or augment, other AI opportunities.

3.11.1. Opportunities involved

As explained in the first phase of study, eight opportunities from the transversal processes were prioritised. They are summarised in the table below.

Table 17: Brief overview of the selected opportunities in initiative 9

Use case ID	Brief description (see Annex B |for a detailed description)
CROSS-1 (Multi-lingual translation)	Multi-lingual translation
CROSS-6 (Forged supporting docs detection)	Identification of fraudulent supporting documents
CROSS-7 (Historical case reasoning)	Consistent decision making (historic case reasoning engine)
CROSS-8 (Ethical monitoring)	AI to monitor the ethicality of other AI systems
CROSS-12 (Forged travel document detection)	Detection of forged travel documents
CROSS-20 (Post application monitoring)	Post application monitoring of TCNs
CROSS-23 (General EU chatbot)	Effective and simplified stakeholder communication
CROSS-25 (Biometric matching)	Improved biometric matching (facial recognition)

3.11.2. Objective and scope

The objective of the initiative is to deliver benefits across multiple processes and to augment already-developed AI applications. The processes in scope are all of those in scope of the study. This initiative supports the strategic objectives mentioned in the previously discussed initiatives.

3.11.3. Benefits

It is expected that upon completion of these opportunities, several benefits will be realised. Most notably, the stakeholders of this initiative can expect the following, whether or not linked to their activities:

- **Improved citizen communication,** by means of multi-lingual communication platforms which are available 24/7, facilitated by machine translation capabilities;
- **Security of the Schengen Area,** by means of pooling information from various sources when performing background checks and monitoring of TCNs within the Schengen Area;
- **Fair application process,** using systems which ensure consistent and ethical decision-making, especially in the context of already using AI within these tasks.

3.11.4. KPIs and success measures

To ensure that the initiative meets its objectives, a number of KPIs and success measures are identified. These will be used to assess the impact of the opportunities present within the initiative. The reader should note and understand that these KPIs are different in nature compared to the ones in previous initiatives. Because of the overarching nature of the initiative, these KPIs are more high-level and transversal. Moreover, the KPIs here could be used in the other initiatives. Specifically, the following KPIs are identified:

Table 18: KPIs related to initiative 9

Key Performance Indicator (KPI)	Reasoning
Usage of AI developed solutions	A higher than expected usage would show that stakeholders see the benefit of the solution and agree using it.

Key Performance Indicator (KPI)	Reasoning
Lead time of various processes	A decrease in lead time would show that various processes happen more efficiently than before.
Cost savings related to the solution	Cost savings would show that the stakeholders can do more with less (or with the same) financial means.
Level of automation in various processes	Various AI opportunities are designed to process individual cases or decisions in an automated manner; a transversal KPI to monitor the level of AI tool usage would be the proportion of these individual cases passing through the automated process pathway.
Overall efficiency improvement of various automated processes	The efficiency of automated processes can be calculated (depending on the individual process) by combining the level of automation metric with the associated cost reduction/increase (for example, individual case worker time saved).

3.11.5. Notable challenges, considerations and relevant risks

With respect to the opportunities in this initiative, few additional considerations can be identified additional to the common challenges and risks defined in 3.2:

- **Access to required data**: Specifically here, CROSS-6 (forged supporting docs detection) will require access to supporting documents (which contain personal information) in digital format (although it is noted that analysis may be performed on aspects of documents which do not contain personal information, such as physical document features like holograms; in this case data requirements would be less stringent);
- **Organisational change:** Use cases such as CROSS-6 (forged supporting docs detection) and CROSS-7 (historical case reasoning) pose significant change to the current organisational process and structure: these two use cases would require officers to use new systems, which demands learning to use them appropriately (i.e. how to use the AI system outputs when drawing their conclusions).

Following the challenges, a number of risks shall need to be acknowledged by means of appropriate preventive actions:

- **Inaccurate results:** A number of opportunities such as CROSS-12 (forged travel document detection) and CROSS-25 (biometric matching) will most likely have a large impact on individuals if the results (false positives and negatives) are inaccurate. Examples include various unjustified claims against an individual (e.g. document fraud). Moreover, the risk of using artificial biometrics (to mitigate data availability challenges) to train CROSS-25 (biometric matching) may have an impact on overall accuracy;
- **High dependency on underlying solutions:** As the vast majority of the opportunities in this initiative builds on the previous initiatives (e.g. CROSS-1, multi-lingual translation, and 7 Historical case reasoning), this initiative is dependent on the success and quality of the work performed before;
- **Technical difficulty:** Some opportunities are placed optimistically on the roadmap in the sense that the technology is not yet proven or still very immature (e.g. CROSS-7, historical case reasoning, and 8 Ethical monitoring). Therefore, it remains to be seen how much the technology will evolve over the coming years, and how feasible the objectives of the opportunities in this initiative become;
- **AI model governance:** An over-arching governance model should be put in place to ensure that application of transversal AI systems does indeed lead to sustained improvement in the operation of other AI tools.

3.11.6. Key stakeholders within this initiative

The following entities can be identified as stakeholders in one or more opportunities within this initiative:

- **DG HOME, and member states** as users and (in some cases) overseeing authority of the AI solution;
- **EU citizens and TCN,** as users of the solutions and data providers.

4 Sequencing of the initiatives and opportunities

This chapter discusses the sequencing approach for the initiatives and opportunities. It starts with the general principles applied for the sequencing task, and moves on to specific sequencing considerations within and between different initiatives.

4.1. Guiding principles for sequencing the opportunities and initiatives

After defining the initiatives, the next step is to sequence the opportunities according to a number of factors. The list below provides a general sense of priorities for these factors (1 typically being the highest priority):

1. **Dependencies:** sequencing is aligned to existing timelines which pose hard technology or process dependencies, such as ETIAS implementation and digitalisation of visa;
2. **Value/feasibility ratio:** using the work performed in the first part of the study, 'quick wins' (moderate or high value and high feasibility) are selected to be executed early in the roadmap to prove the value of AI;
3. **Strategic drivers:** EU & DG HOME vision and mission and strategic objectives for the next years are implicitly considered in the sequencing;
4. **Logical sequence within the process:** the roadmap starts with simpler AI opportunities and builds incrementally in complexity;
5. **Technology:** opportunities are grouped logically to ensure synergistic overlaps to share knowledge and effort;
6. **Balanced workload:** the roadmap has a consistent workload profile to maximise the chance of success and avoid bottlenecks.

4.2. Rationale for sequencing

This section explains the sequencing of opportunities within and between initiatives, describing the different elements that should be taken into consideration and where possible knowledge overlaps might be useful.

As noted in chapter 2, the year 2020 is left relatively empty. This is because this year will be used to prepare the development of the AI solutions in terms of connecting with the interested parties, find appropriate funding, scoping the opportunities tailored to the context and others. Therefore, opportunities scheduled in 2020 only contain a Proof-of-Concept (PoC) stage. Additionally, enabling elements could also be launched (see chapter 6 for more details).

4.2.1. Within the initiatives

This first section zooms in on the specific initiatives. The rationale behind is that it is easier to familiarise with smaller parts of the roadmap first, before taking a step back and understanding the big picture. Nonetheless, readers are free to skip this subsection and go to section 4.2.2 immediately.

Initiative 1: Visa issuance for short-stay

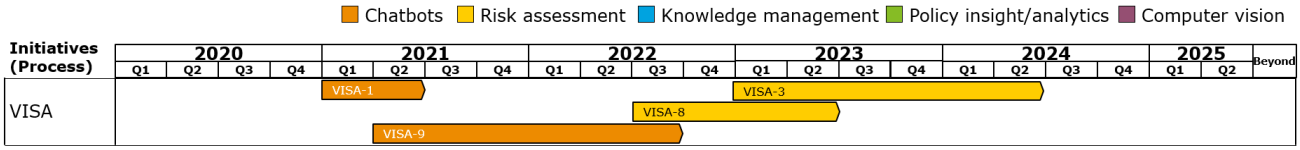


Figure 4: Sequence of the opportunities in initiative 1

The initiative would start with the technically most straightforward use case (VISA-1 - application chatbot), which is a virtual assistant to support TCNs in the application process. The opportunity is highly feasible with substantial expected value for its users. It is also expected that it would be relatively easy to develop alongside the current visa process. The start of 2021 is seen as the optimal start time as this leaves time for required preparations in 2020 while still providing a chance to benefit from synergies in the digitalisation of visa process (i.e. similar analysis), which is planned for mid-2020.

Similarly, VISA-9 (tailored application form) is expected to benefit from synergies with the definition phase of the visa digitalisation roadmap. The small overlap with VISA-1 (application chatbot) is intentional on the timeline as both address common objectives: VISA-9 (tailored application form) could even be incorporated into the solution built in VISA-1 (application chatbot), i.e. delivering personalised applications through some form of chatbot interface.

VISA-3 (application triaging) and VISA-8 (identification of irregular travelling patterns) are moved later into the roadmap due to the expected workload posed by the digitalisation of visa in the next two years. Furthermore, VISA-8 (identification of irregular travelling patterns) is proposed for launch prior to VISA-3 (application triaging) as VISA-8 (identification of irregular travelling patterns) could essentially be a building block for 'plugging in' to VISA-3 (as an additional piece of risk analysis).

Initiative 2: Issuance of an ETIAS travel authorisation

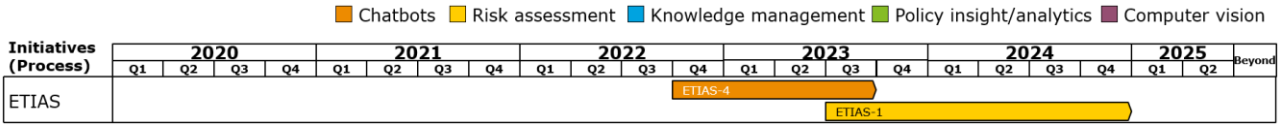


Figure 6: Sequence of the opportunities in initiative 2

Similarly to VISA, the initiative would start with the most straightforward opportunity first: ETIAS-4 the virtual assistant for applications (i.e. application chatbot). ETIAS-1 (risk assessment) is moved more to the back due to complexity and placed after VISA-9 (tailored application form) due to similarities and possible knowledge overlaps.

The most important factor for both opportunities is the actual implementation of the ETIAS system, which is expected at the end of 2022. Implementation of ETIAS-4 (application chatbot) would therefore only start at the end of 2022. Running work in parallel could potentially facilitate additional synergies between the development of the system and the integration plans for the AI. Additionally, ETIAS-4 (application chatbot) could be useful for providing information to third-country nationals as part of the ETIAS information campaign, prior to the launch of the ETIAS system. Example questions could include the current FAQ (e.g. "what is ETIAS", "am I eligible for an ETIAS", etc.). Additionally, over the course of the first months, the chatbot could be implemented to support applicants during the process of filling in the required form.

ETIAS-1 (risk assessment) is scheduled later due to lack of data before the start of 2023 (as ETIAS is not yet in production), and will use the data from the first six months of 2023 for the creation of the AI model.

Initiative 3: Issuance of docs for long-term stay or residence in the Schengen Area

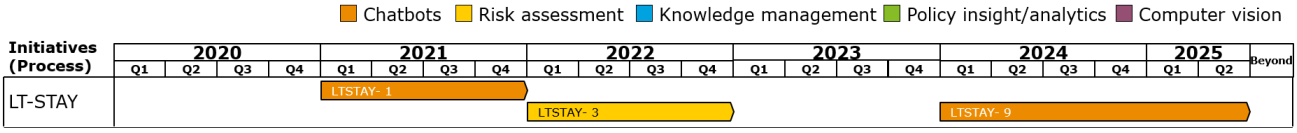


Figure 7: Sequence of the opportunities in initiative 3

Just like VISA and ETIAS, this initiative sequence starts with the most straightforward opportunity (LTSTAY-1, the application chatbot or virtual assistant). LTSTAY-3 (application triaging) comes next due to its expected high value. LTSTAY-9 (moving within the Schengen area) is moved further along the timeline due to its higher technical complexity and the need for a regulatory body to enable scaling of the solution.

Initiative 4: Granting international protection

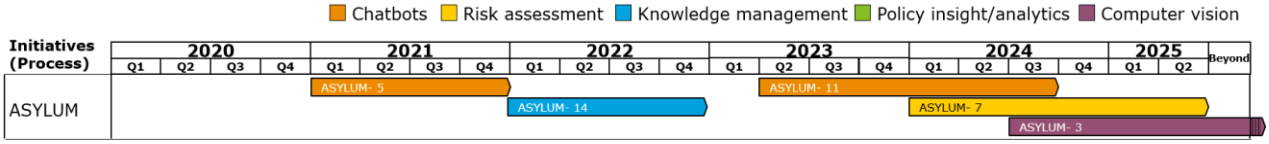


Figure 8: Sequence of the opportunities in initiative 4

In this initiative, the two most feasible and strategy-aligned opportunities are sequenced first. As with other initiatives, the first opportunity (ASYLUM-5, registering chatbot) is chatbot-based, meaning technically straightforward and bringing benefits such as easing the registering processes for applicants (faster) and authorities (less manual work). Furthermore, synergies between the other chatbots in ETIAS, VISA and LTSTAY are possible. The second opportunity, ASYLUM-14 (intelligent search engine), would support officers in making critical decisions related to security and human compassion and can leverage Natural Language Processing (NLP) text analytics (e.g. data validation) which may feature in ASYLUM-5 (registering chatbot). ASYLUM-14 (intelligent search engine) would also benefit from synergies with SISSIRENE-4 (knowledge search/management tools) and so is sequenced to deliberately fall in parallel. ASYLUM-11 (refugee allocation) can use chatbots developed in previous opportunities, but will require historical data to create the model (which could be difficult to obtain). It is also placed such that it links with LTSTAY-9 (moving within the Schengen area). The two last opportunities, ASYLUM-7 (abscondment risk assessment) and ASYLUM-3 (vulnerability assessment) are placed later in the roadmap due to their technical complexity. Specifically, ASYLUM-3 (vulnerability assessment) is an example of 'emotion AI' which has not yet been rigorously demonstrated and inaccuracies would have a serious negative impact: false positives impacting operations and false negatives being undesirable due to the sensitive human context (similar risks are true for ASYLUM-7, abscondment risk assessment).

Initiative 5: Consultation of the SIS and involvement of SIRENE Bureaux

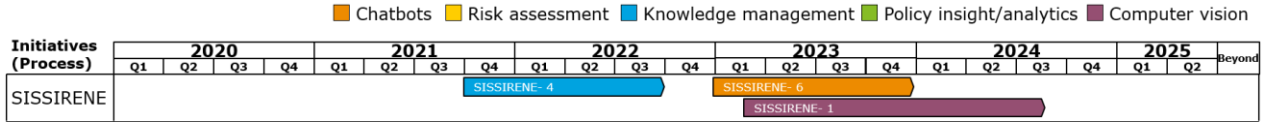


Figure 9: Sequence of the opportunities in initiative 5

In this initiative, SISSIRENE-4 (the Knowledge Management (KM) tool for SIS) is sequenced first, as the technology is relatively mature (but should follow other chatbot developments to maximise chance of

synergy). Moreover, synergies with ASYLUM-14 (intelligent search engine) and other NLP solutions will be possible at this point in the combined roadmap. SISSIRENE-6 (automatic form completion) may then be able to benefit from reusability of the knowledge search functionality or metadata improvement developed as part of SISSIRENE-4 (knowledge search/management tools). Finally, SISSIRENE-1 (alert detection) is sequenced last due to expected technological and operational complexity: including but not limited to deployment infrastructure considerations and privacy regulation.

Initiative 6: Schengen border checks

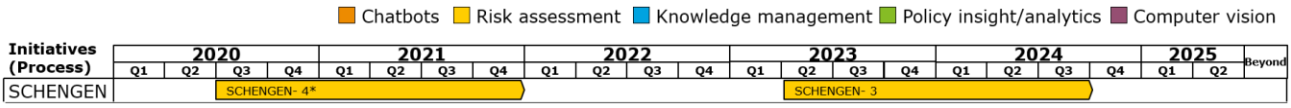


Figure 10: Sequence of the opportunities in initiative 6

The two opportunities in this initiative are sequenced such that the one with the highest value and feasibility scores, SCHENGEN-4 (border flow analytics), is placed first. This is aligned with the strategic objective *"improving security in the Schengen Area"*. SCHENGEN-3 (triage border crossings) can then follow, as insights from SCHENGEN-4 (border flow analytics) are helpful for understanding border flow dynamics and are useful to develop risk triage mechanisms.

Initiative 7: Operational management of systems and infrastructure at eu-LISA

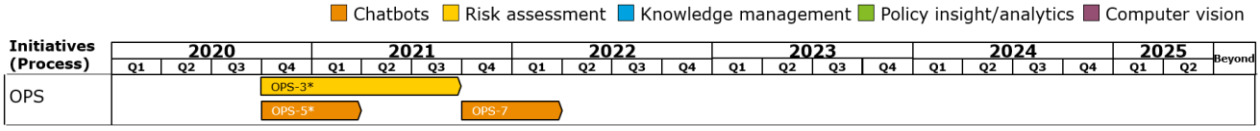


Figure 11: Sequence of the opportunities in initiative 7

Like other initiatives, the most straightforward opportunity (OPS-5, Triaging chatbot for L1/L2) is chatbot-based and might be planned towards the start of the sequence (virtual assistant for triaging L1 and L2 requests)[24] given its feasibility (and related opportunities in other initiatives – see next section). Nonetheless, it is expected to bring significant value by automating a number of tasks, freeing Agency capacity for other high priority work. OPS-3 (incident prediction) happens in parallel, as having automated service desks from OPS-5 (triaging chatbot for L1/L2) could complement the efficient triage component in OPS-3 (incident prediction) (and hence provide more resource availability). Finally, OPS-7 (learning chatbot) comes later in the sequence as it addresses a concern which is less immediate for eu-LISA (this might change with upcoming new systems or implementation of Interoperability components).

Regarding the timing of OPS-3 (incident prediction) and OPS-5 (triaging chatbot for L1/L2), it should be noted that Q4 would only encompass work at PoC-level.

Initiative 8: EU policy making and enforcement process

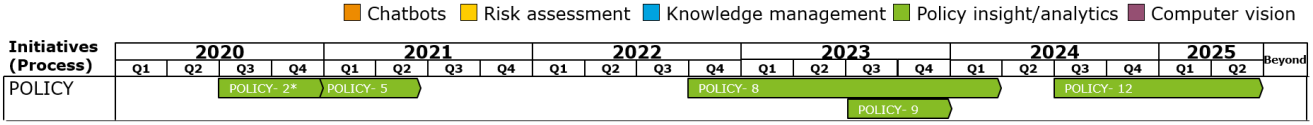


Figure 12: Sequence of the opportunities in initiative 8

[24] Due to changes in priorities and unavailability of budget/resources, this might be planned later into the roadmap.

Here the two 'quick wins', POLICY-2 (linking of regulations) and POLICY-5 (clustering of regulations) are sequenced first and follow each other due to their similarities and hence possibility to reuse and build upon. Also, technical solutions for these opportunities exist in the market, so implementation is expected to be straightforward. These two opportunities could also be combined into one, larger solution. Therefore, they could be merged as one (as depicted in the roadmap).

POLICY-8 (automated newsgathering) is next, which is seen as more technically difficult due to the potential breadth of data under analysis. However, it can build on previous NLP use cases and the expertise developed within DG HOME. POLICY-9 (effective stakeholder communication) is dependent upon availability of well-structured data, which would become available during the development of POLICY-8 (automated newsgathering), and is therefore sequenced more to the end of that opportunity. Finally, POLICY-12 (predicting policy acceptance) is placed last due to its technical complexity and certain ethical considerations that need to be addressed prior development. Note that POLICY-12 (predicting policy acceptance) might be sequenced earlier and overlap with the end of POLICY-8 (automated newsgathering), depending on the sufficient ability to access well-structured data.

Initiative 9: Transversal processes

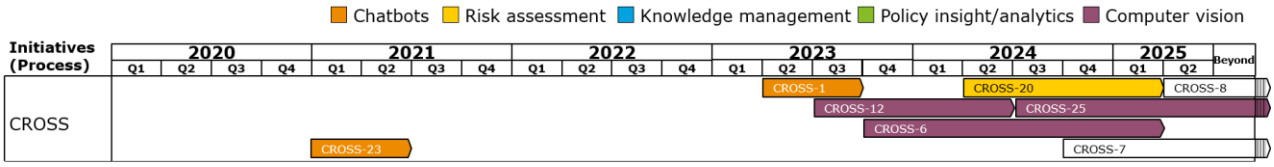


Figure 13: Sequence of the opportunities in initiative 9

In this final initiative, the same reasoning as in the previous initiatives is followed: CROSS-23 (General EU chatbot) is positioned first which is the most straightforward and general chatbot, and can act as a 'launch pad' for the following chatbots (visa, ETIAS, etc.) by providing the core development features, and technical/non-technical approaches. CROSS-1 (multi-lingual translation) is positioned significantly later in the roadmap despite a relatively high expectation for technical feasibility. This is because it would be leveraged within other opportunities: the different chatbots, most of which should be developed first before applying translation techniques. However, in some cases it might be beneficial to start a specific translation of a chatbot already. Secondly, translation of documents (e.g. supporting elements in a visa application) needs to be digital first (or structured) such that they can be translated by an AI model. This processing would be done by CROSS-12 (forged travel document detection) and CROSS-6 (forged supporting docs detection), re-using elements of the model created in CROSS-1 (multi-lingual translation). Next, CROSS-20 (post-application monitoring) is positioned in between CROSS-12 (forged travel document detection) and CROSS-25 (biometric matching) since the documents analysed in these latter opportunities may provide evidence signals for AI performing analysis of TCN conditions. CROSS-7 (historical case reasoning) and CROSS-8 (ethical monitoring) are technically challenging and require historical data which is currently only partially available, hence are placed further along the roadmap to wait until further digitalisation in each of the processes.

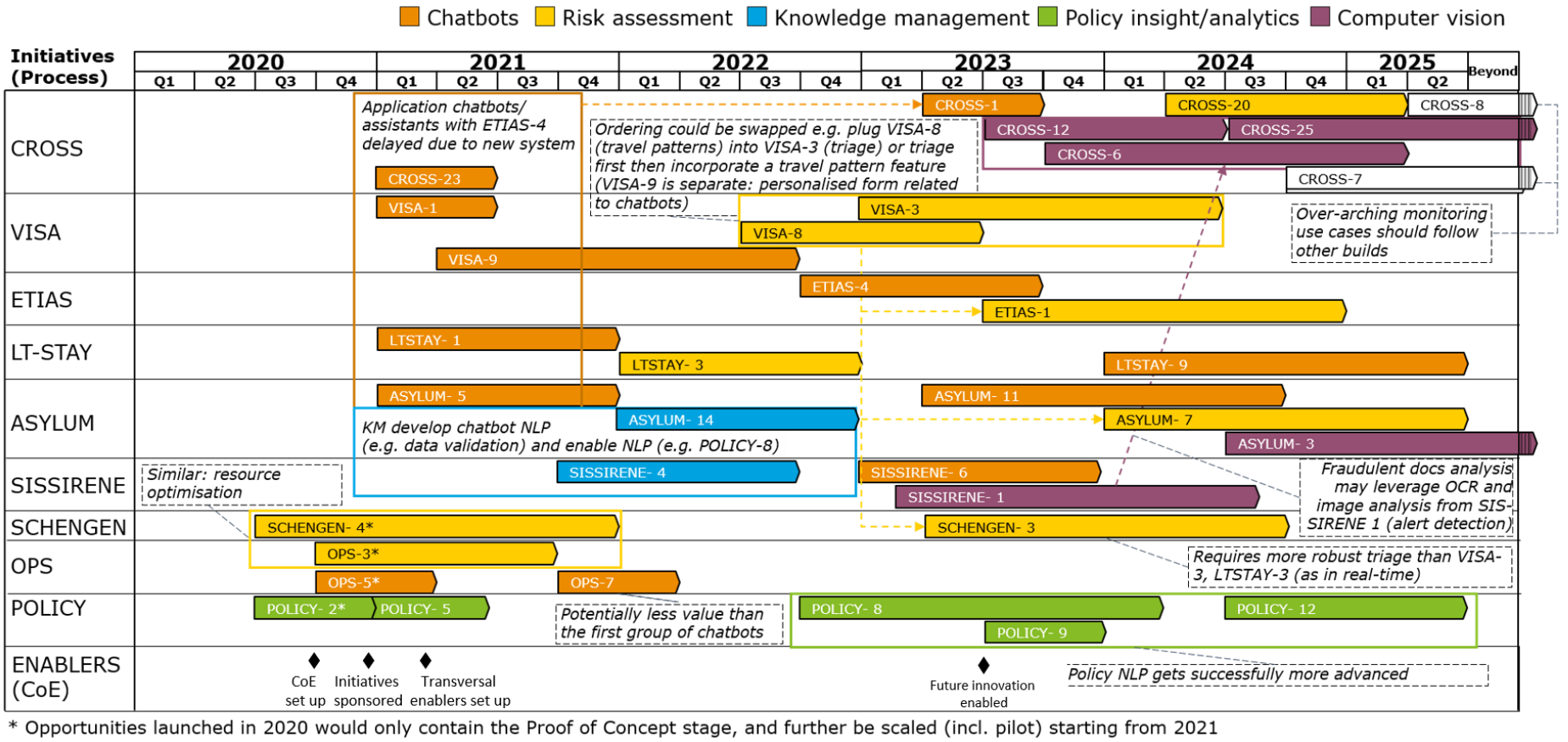
4.2.2. Between the initiatives

This subsection describes in more detail sequencing considerations of opportunities across the different initiatives. The figure on the following pages provides a visual overview of the roadmap itself. Finally the chapter is concluded by highlighting the critical project path.

Further sequencing considerations

Looking at the roadmap, the following observations can be made:

- Following CROSS-23 (general EU chatbot), the application and migration chatbots VISA-1 (application chat), LTSTAY-1 (application chatbot), ASYLUM-5 (registration chatbot) should be run as effectively one project, due to the similarity of scope, objective and technology, and this would be facilitated by the enabling activities as described in Chapter 7. In particular, core chatbot functionalities developed as part of CROSS-23 (general EU chatbot) may constitute a form of template or toolkit to be adapted for subsequent chatbot developments. Separately, OPS-7 (learning chatbot) is addressing a lower priority concern for eu-LISA so may drive less value, and hence could come later.
- SCHENGEN-4 (border flow analytics) and OPS-3 (incident prediction) are both around resource optimisation/allocation so may benefit from shared learnings.
- SISSIRENE-4 (knowledge search/management tools), especially if developed in a chatbot interface, and ASYLUM-14 (intelligent search engine) facilitate a link between developing simpler NLP (such as the autocomplete/validation functionalities in application chatbots) and more advanced NLP (such as that applied in Policy). In particular, POLICY-8 (automated newsgathering) may benefit from intelligent data management of ingested information (e.g. to tag metadata).
- VISA-3 and LTSTAY-3 (both application triaging) are related as both are application triage use cases; in contrast, ETIAS-1 (risk assessment) would have more decision-making power (to accept/check further as opposed to only triage) and hence should be delayed to manage the technical risk (of bias etc.) and political implications. Similarly, SCHENGEN-3 (triage border crossing) may use similar data and, since it is applied 'live' at the border (as opposed to retrospectively on a delayed stream of data) would require a more robust solution, so could follow development of the first two. It may also benefit from VISA-8 (travel patterns) being developed to 'plug-in'.
- CROSS-1 (multi-lingual translation) may benefit not only from following the chatbots, but also KM and Policy NLP use cases e.g. POLICY-8 (automated newsgathering), i.e. CROSS-1 applied to translate news sources).
- ASYLUM-11 (post-entry chatbot) is about drawing together individual factors and destination country/region factors (e.g. labour market analysis) – as such it may benefit from following triage and individual risk use cases. It may also make sense for Asylum to prioritise ASYLUM-14 (intelligent search engine) since this may create positive learnings related to SISSIRENE-4 (knowledge search/management tools) and POLICY-8 (automated newsgathering) sooner.



* Opportunities launched in 2020 would only contain the Proof of Concept stage, and further be scaled (incl. pilot) starting from 2021

Figure 14: Overview of the roadmap with some highlights of the sequencing rationale

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Furthermore, a number of technology groups can be identified, providing a good picture of the different types of activities in the roadmap. The figure below provides an overview (see Annex A | for a larger figure):

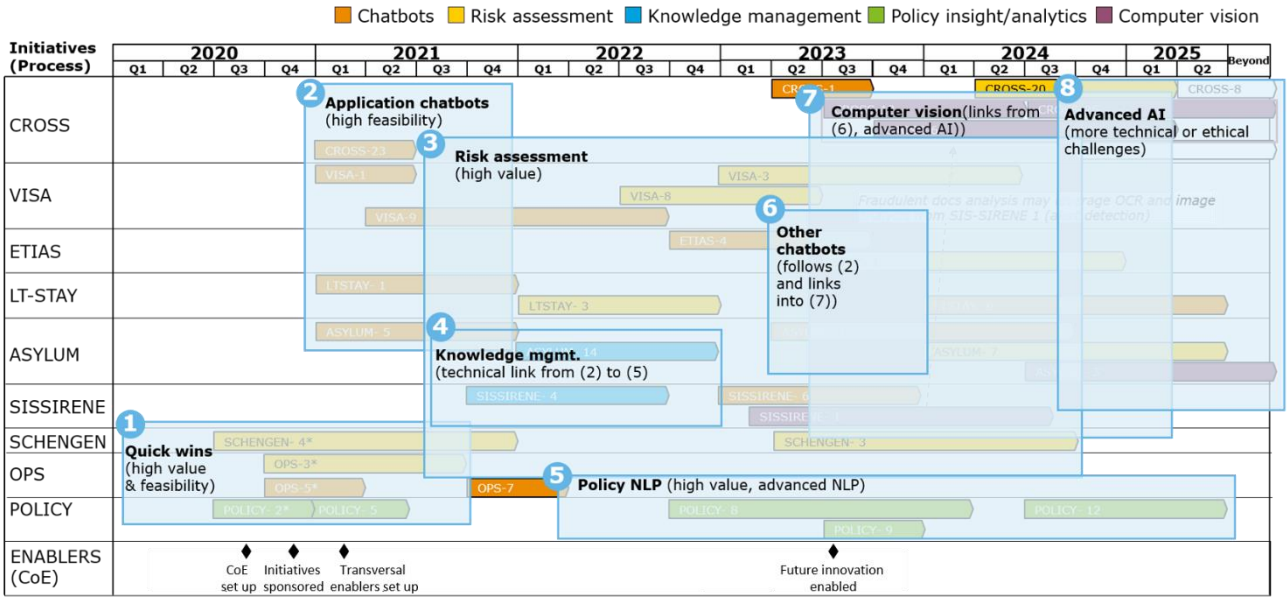

Figure 15: Overview of the different technology groups

4.3. Critical project path

To finalise this chapter, a reflection on the so-called 'critical project path' of the roadmap is given. With this, the steps in the roadmap most crucial for a sequence of successful implementations are highlighted. It should be noted that there is not, other than a few discrete exceptions, an over-arching path of projects critical at the programme-level. The roadmap in this work was created such that the overall benefit is maximised while providing some level of flexibility: indeed, this roadmap should been seen as a tool where it can be tailored where needed in the future. Not every stakeholder (e.g. Member state) will have the same objectives and priorities. Nonetheless, a few critical elements shall be necessary to be taken into account:

- **Setup of enabling factors** such as ensuring availability and best practices on areas like technological infrastructure, data, talent, will be required prior to developing any AI opportunity (see Chapter 6). The CoE model (see section 6.2) suggested for addressing these tasks is placed very early in the roadmap in order to maximise the benefit brought by this enabling capabilities.
- **Specific dependencies on existing timelines** are inevitable elements that are critical to the roadmap. Examples include the ETIAS implementation, VISA digitalisation roadmap and specific developments/other activities within the agencies (e.g. eu-LISA).
- **Overarching AI opportunities** such as machine translation capabilities (CROSS-1) and ethical AI (CROSS-8) are dependent on there being AI solutions on which to apply them, so they should necessarily come later in the roadmap. While this also respects the general approach opted by the roadmap of beginning with high feasibility opportunities, it should be mentioned that this is not critical for overall programme success (however it is seen as maximising the likelihood of success while minimising additional development and implementation work).

5 Zoom-in on the opportunities and related projects

This chapter sets out a general approach to the implementation of AI solutions, followed by specific observations related to the AI opportunities under evaluation in this study.

5.1. General approach to build, test and scale AI solutions

5.1.1. Overview

Artificial Intelligence projects are inherently complex and present novel challenges, even to those organisations who are used to implementing technological change. For many projects in this space, obtaining and preparing the data required, sourcing and coordinating the required resources, technical and process know-how and leadership buy-in, can all pose difficulties, especially when projects rely on having some freedom for experimentation, or have a high degree of uncertainty.

To address business and technical requirements in a structured manner, and to mitigate the risk from technical complexity and flexibility, AI projects usually run with a phased approach. This would begin with a tightly scoped **Proof-of-Concept** (PoC) designed to prove the core value hypothesis. This then would be followed by a **Minimum Viable Product** (MVP) pilot test in some form of representative business-as-usual scenario or simulation (to validate the core of the opportunity as functioning inside business processes). Finally an integration and roll-out as the **opportunity is scaled** for usage in core operations. These various stages can be indicatively mapped to the European Commission's designations of Technology Readiness Levels (TRL) as set out in Horizon 2020 documentation[25]. A PoC may range from:

- TRL 3 (experimental proof of concept) – for those AI opportunities where the core AI modelling hypothesis is decoupled from the future system design, e.g. SISSIRENE-1 (alert detection) where a PoC is likely to be more focused on proving the image analytics techniques as opposed to integrating into operational systems,
- or TRL 4 (technology validated in a lab) – for example if developed in a simulated platform (see chapter 7 for discussion, as this is a potential CoE capability);
- up to TRL 6 (technology demonstrated in relevant environment) – for those AI opportunities where the core AI modelling hypothesis is intrinsically linked to developing the targeted technology (e.g. chatbots where PoC development begins in a production-ready platform (see 5.2.1 for details)).

An MVP may then range from TRL 6 up to:

- TRL 7 (system prototype demonstration in operational environment) – with a performant AI solution tested/validated or effectively deployed at a subset of end users,
- or TRL 8 (system complete and qualified) – with a finalised AI solution.

Scaling then takes the AI opportunity up to TRL 9 (actual system proven in operational environment) when it is deployed at all target end users.

[25] See https://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2016_2017/annexes/h2020-wp1617-annex-g-trl_en.pdf

Each of these three phases can be considered as an individual project underlying each of the opportunities in the main roadmap. However, not every use case necessarily requires all three distinct steps, as there may be synergies and learnings which facilitate a more accelerated implementation of other use cases (as noted in section 4.2). The specific stakeholders in each project could also depend based on the AI opportunity being implemented. Process or relevant data expertise would come most readily from the Agency or member state end users, while monitoring and overall direction may be more suitably coordinated from a central governance body (see section 6.2).

The duration of this phased approach ranges, based on complexity of the individual AI use case, from approximately 9 to 18 months in total. The majority of variation is found in the scaling (final) phase. In this study, indicative duration estimates are provided in the roadmap based upon the feasibility analysis documented in the first report, whereby categories of high/medium/low scoring use cases were mapped against a low/medium/high scaling duration:

Table 19: Scaling complexity categorisation based upon feasibility

Use case ID	Short name	Feasibility score	Scaling complexity
VISA-1	Application chatbot	3,9	LOW
VISA-3	Application triaging	3,1	HIGH
VISA-8	Identification of irregular travelling patterns	3,0	MEDIUM
VISA-9	Tailored application form	2,8	HIGH
ETIAS-1	Risk assessment	2,5	HIGH
ETIAS-4	Application chatbot	3,6	MEDIUM
LTSTAY-1	Application chatbot	3,7	MEDIUM
LTSTAY-3	Application triaging	3,5	HIGH
LTSTAY-9	Moving within the Schengen area	3,4	HIGH
ASYLUM-3	Vulnerability assessment	2,9	HIGH
ASYLUM-5	Registration chatbot	3,9	MEDIUM
ASYLUM-7	Abscondment risk assessment	3,0	HIGH
ASYLUM-11	Refugee allocation	3,2	HIGH
ASYLUM-14	Intelligent search engine	2,8	MEDIUM
SISSIRENE-1	Alert detection	3,5	HIGH
SISSIRENE-4	Knowledge search/management tools	3,8	MEDIUM
SISSIRENE-6	Automatic form completion	3,9	MEDIUM
SCHENGEN-3	Triaging border crossings	3,3	HIGH
SCHENGEN-4	Border flow analytics	2,9	HIGH
OPS-3	Incident prediction	3,6	MEDIUM
OPS-5	Triaging chatbot for L1/L2	4,0	LOW
OPS-7	Learning chatbot	3,9	LOW
POLICY-2	Linking regulations	4,7	LOW
POLICY-5	Clustering of regulations	4,4	LOW
POLICY-8	Automated newsgathering	3,0	HIGH
POLICY-9	Effective stakeholder communication	4,3	LOW
POLICY-12	Predicting policy acceptance	3,2	MEDIUM
CROSS-1	Multi-lingual translation	4,0	LOW
CROSS-6	Forged supporting document detection	2,7	HIGH
CROSS-7	Historical case reasoning	2,6	HIGH
CROSS-8	Ethical monitoring	3,6	HIGH*
CROSS-12	Forged travel document detection	3,6	MEDIUM
CROSS-20	Post application monitoring	3,9	MEDIUM
CROSS-23	General EU chatbot	4,6	LOW
CROSS-25	Biometric matching	3,2	HIGH

*classified as High complexity due to expected technical aspects and related challenges

The overall phased approach demonstrates a small example of the broader AI journey that an organisation would take. An organisation looking to become truly 'AI-fuelled' would progress from assisted to augmented to autonomous processes[26], just as an individual AI use case would move from standalone to semi-connected to fully integrated.

While individual projects should be governed with appropriate risk management, this section focuses more on those aspects of projects not already addressed by enabling initiatives as discussed in the previous section.

5.1.2. Proof-of-Concept (PoC)

The purpose of the Proof-of-Concept is to test the core idea of the AI opportunity in a pragmatic way that minimises time and cost, and quickly answers any uncertainties. These uncertainties can exist for a number of reasons, most commonly, they are rooted in the inherent difficulty in defining with certainty how accurate and effective an AI system can be until data has been analysed and initial outputs have been assessed.

Successful are those which:

- form a more accurate view of how effective and valuable the solution can be,
- develop the "core" AI logic of a solution in a manner that is re-useable,
- set the foundation for and accelerate future development phases,
- develop understanding of the future requirements that need to be in place to scale the solution.

The PoC phase can be split into three timeline components. First, the solution design is constrained through a scoping exercise, which articulates what is needed to answer the core objective of the use case: "what is the PoC aiming to prove and what is the minimum we must do to test this". Then, the solution is built, usually in an iterative and agile manner, with appropriate oversight such as 'go / no-go' checkpoints (to allow for rapid refocusing of efforts if initial findings suggest poor feasibility). Finally, the built PoC is validated against suitable success metrics. PoC's typically should be time restricted to 2-4 months, with 25% to design, 50% to build and 25% to validate.

A multidisciplinary team is required to build an AI PoC. There must be a range of skills covering the existing process (from operational, technology and regulatory perspectives) and the future solution (from data science and engineering perspectives) as well as individuals providing overall direction and accountability.

A typical PoC delivery team would run with the equivalent of 3-4 full-time individuals working at any one time over the 2-4 month timeframe, with roles spanning:

- A data scientist, responsible for the technical development of AI approaches, iteration of AI models and evaluation of mathematical effectiveness of the solution, involved for the entire project.
- A business analyst or nominated process officer, responsible for understanding existing processes, assessing requirements and evaluating solution benefits and next steps, involved during the design and validation activities.
- A data engineer, responsible for the development of code pipelines for data cleansing, aggregation and transformation, as required by the AI approaches, involved during the build and validation activities.
- A project manager, responsible for day-to-day project oversight and governance, status reporting to senior stakeholders and alignment across broader groups (such as related AI initiatives), involved for the entire project.

[26] Deloitte Insights: AI-fueled organisations (Jan 2019) - https://www2.deloitte.com/us/en/insights/focus/tech-trends/2019/driving-ai-potential-organisations.html

» Oversight and subject matter expertise to be provided by senior management and technical AI experts, expected periodically at key decision points in the project.

Throughout the project, there would also need to be various engagement with external stakeholders (i.e. individuals outside of the core delivery team). This would generally include process experts, data managers and IT administrators and would be relatively limited in scope.

Project-specific factors would influence resourcing decisions. Significant member state (and/or Agency) specifics that are present across a single AI opportunity (for example different member states working with incompatible local systems of some kind) may necessitate local staffing of the more technical resources. In other words, the data scientist, business analyst and data engineer may require local specialist knowledge (or there may simply be more effort required for dealing with the variation) and so may need to be sourced from different member states. However, there is also benefit to be gained from deploying central resources as these individuals would be expected to gain expertise by working on multiple AI opportunities.

There are also different technical skill profiles that would be more suitable to different AI solutions. A chatbot would require a data scientist with more experience in natural language processing (NLP) and user testing, a risk assessment tool would require more of a statistical analysis background, and knowledge management (KM) and computer vision development projects also lend themselves to more specialised AI backgrounds. Insight-type AI may require more data visualisation skills (for communicating the results to users) while automation-type AI may require more data engineering skills.

More senior team members would also be more efficiently utilised from a central position. Individuals in project management, governance and stakeholder coordination roles should be granted mandates covering AI implementation at the Initiative-level where appropriate. Furthermore, effort should be made at the Directorate-General or Commission level to coordinate knowledge sharing and other useful overlaps between related projects (see chapter 6 for more details on maximising synergies from a central perspective). For specific commentary on resourcing as related to the initiatives in this study, see section5.3.

The three components of a PoC commonly follow a set structure:

The **first component ("design")** of the PoC phase is about designing the AI solution and can be split into two types of analysis:

- business requirements analysis to develop an understanding of exactly where AI is to be applied in the process in question, what outputs the AI should give and how this should be evaluated;
- data analysis to understand how to achieve this given the existing data, technology and AI capability context.

The objective is to constrain the solution to limited but representative inputs (data) and outputs (functionalities), with minimal systems integration and a clear set of KPIs and/or success metrics to monitor performance. Data analysis may require some initial development environment set-up for exploratory data analysis (potentially on samples of data). Business requirements analysis may be achieved via interviews and process mapping, for example.

Implicit here is the need to develop an understanding of potential variation in data across eventual end users. A representative set of data is one providing sufficient technical and strategic assurance for continuing solution development. The specific data needed will depend on the AI opportunity. If it is known that different member states (for example) have significantly different data availabilities or formats, then PoC work would be needed to assess the various configurations. On the other hand, if data is generally the same at different

member states then a PoC would likely be targeted on a single representative member state and then extended at MVP stage as more stakeholders see deployment.

A more involved data analysis may include value assessment of the expected impact of the AI solution (e.g. for prioritisation purposes), but this study has already developed strategic and prioritisation rationale. Otherwise, data analysis should investigate data availability, curation/quality, volume/velocity and externality (where required). Upon completion of this phase there should be:

- an understanding of which data is most important, what volume is required and if any anonymisation is required;
- an agreement of which outputs are most important for the solution to generate; an extraction of appropriate data to facilitate the development ("build") stage;
- appropriate infrastructure available for development.

The **second component ("build")** of a PoC project is typically a set of agile development sprints, rapidly trialling data transformations and iterating on AI models to address the requirements established in Design. This phase should see engagement with wider stakeholders where appropriate, to ensure:

- alignment with processes, regulation and people;
- opportunity to understand more from the data and interim modelling outputs.

In accordance with the PoC principle of proving the core hypothesis, this engagement should be sufficiently broad to understand representative inputs and outputs, but otherwise as limited as possible.
If the AI opportunity is for eventual deployment at multiple member states (or Agencies) then effort should be taken to minimise duplication of technical work, for example by engaging with a single (or representative set of) member state(s).

Developing code for a single PoC is preferable to developing multiple different PoC's, unless there are specific challenges which need to be solved for proving the core hypothesis – in this case, a central body should provide coordination of development teams working with individual member states. Simpler AI techniques should be prioritised over more complex techniques, and pure performance/accuracy should be balanced against factors such as model interpretability and acceptance by non-technical users. Nonetheless, research in general may help to inform the overall approach.

In parallel to the technical development of the AI solution, business analysis is carried out in order to further understand future requirements (for integration, maintenance and monitoring). Given the multi-stakeholder context of the European Commission, these future requirements should be considered in light of wider technology transformations, with effort taken to note synergies with other AI opportunities (see section 5.2).

The **third component ("validate")** is where the PoC AI solution is assessed against the agreed success metrics. This would depend upon the specific AI opportunity, but a typical approach would be to trial the solution on a historic selection of data (which should be fairly sampled and withheld from AI model training) or against the existing process (e.g. scores given by a human rather than the AI).

The responsibility for this testing would generally sit with the technical development team, working with process specialists to understand implications of the assessment. At the PoC stage, each instance of an AI solution should be validated separately (for example, if multiple prototypes have been developed for different member states).

This exercise results in mathematical accuracy metrics that illustrate the solutions effectiveness, and comparative business measures that help translate this into a more accurate view of how much value the solution can bring to core operations. This value estimation is to be assessed on balance with the future requirements (for scaling and integration). If the PoC performs favourably, then it is suitable to progress in development with broader functionalities, integration and more involved testing. Otherwise, further development at PoC stage, or reconsideration, may be required.

5.1.3. Minimum Viable Product (MVP)

The purpose of the Minimum Viable Product phase is to further develop a PoC solution to a level where value and feasibility can be tested in a more representative scenario, to unlock real user-facing deployment. For those AI opportunities already validated to an appropriate level (e.g. chatbots that come later in the roadmap), an MVP phase may not be necessary. Alternatively, a PoC project could potentially extend directly into an MVP project if progress and momentum is sufficient to justify accelerating along the development curve, and this should be considered on a case-by-case basis.

Broadly, an MVP project would follow a similar structure to that outlined for PoC, with analysis to inform development, and then testing. It differs from a PoC in that successful testing should enable the tool to be deployed in a production environment (i.e. into the real process). Therefore, initial analysis would aim to scope out a broader set of inputs (data) and outputs (functionalities), and may at this stage require some systems integration (e.g. for automated data ingestion). Similarly, testing would ideally be with real users (such as in a Beta format or with a pilot set of users). Deploying in pilot like this would give workers a chance to interact with and understand the tool, minimising potential future issues around lack of acceptance.

MVP projects typically take 3-6 months, depending upon the solution complexity and the breadth of associated data, systems and stakeholders. This duration would generally split into 20% design, 50% build, 20% validate and 10% of future scaling planning.

Similarly to building a PoC, a multidisciplinary team is required to build an AI MVP. There must be a similar range of skills covering the existing process (from operational, technology and regulatory perspectives) and the future solution (from data science and engineering perspectives) as well as individuals providing overall direction and accountability. However, the mix of these requirements is usually different once an implementation has progressed to the level of MVP.

A typical MVP delivery team would run with the equivalent of 3-4 full-time individuals working at any one time over the 3-6 month timeframe. The mix differs from that expected during PoC in that:

- The data scientist is responsible for interpreting results (including testing), optimising the PoC functionality (which by now is a proven concept), and incorporating any additional functionality. There should be less AI-specific design activity at this stage, and more of the build effort would come from the data engineer than at PoC. However, there would also be effort required to design a more robust and production-ready solution, potentially from a similar data scientist resource or from a more specialist solution architect (perhaps more relevant for AI opportunities which are to be deployed at multiple stakeholders, and less relevant for AI opportunities designed for internal deployment).
- The business analyst or nominated process officer is responsible for understanding testing requirements as well as future scaling requirements, involved during design, validate and future scaling planning activities.
- The data engineer is responsible for incorporating a broader set of data inputs, creating the data pipelines to handle these, and progressing systems integration activities. They should also work to

set-up and test live environments for usage of the AI solution. Proportionally more of the build effort would come from the data engineer than at PoC.

- Additional user interface (UI) development skills would be required to create user-facing components of certain use cases (for example SISSIRENE-1 (alert detection) or ASYLUM-3 (vulnerability assessment)) where timely and accurate interpretation of results is key. For more external-facing use cases, such as ASYLUM-5 (registration chatbot), user experience (UX) research and design skills may be needed.
- The project manager is responsible for any user testing, as well as day-to-day project oversight and governance, status reporting and alignment, and is involved throughout the project.
- There may still be oversight and subject matter expertise periodically provided by senior management and technical AI experts.

In the context of the European Commission, it is noted that true production pilots (which impact the existing process) could require a new legal basis if the pilot approach would no longer comply with existing legal reference. However, most AI opportunities in this study present an alternative technological option for an existing process. They do not change which data are collected nor the processes themselves, rather they change the technical means for using these data. As such, there is at this stage no need for additional legislative work required.

5.1.4. Scaling

The purpose of the Scaling phase is to deploy and roll-out the AI solution into its targeted production setting, for example within the policy making functions of DG HOME or other processes across member state bodies. Scaling projects may also see continued development of any remaining functionality, or the creating of a backlog for future work. The duration of this phase could vary from approximately 3 to 9 months, and this is reflected in the roadmap with the aforementioned scaling complexity classification (which was based on the feasibility score developed during the first part of this study, as explained in 5.1.1).

Technical aspects of this phase would include code productionisation (engineering code to a production-level quality which means it is cleanly written and documented, tested and secure) and systems integration at the deployment location (ensuring appropriate connections to APIs, databases, and other downstream systems where data needs to be stored or actions need to be automatically triggered and processed). The specifics of deployment infrastructure would also need to be agreed with appropriate forward-looking analysis to ensure that options align to any other planned system architectures. Common options include Cloud-based versus 'on-premises' (deployment to infrastructure owned/managed by the organisation, for example eu-LISA systems). A Cloud approach is often faster and more flexible, with managed scalability and service integration which could be used to create a broader technology platform (by integrating into services like security and identity management tools, data processing and analytics tools, and reporting tools). However, an on-premises approach can be easier to fit to existing security and networking requirements.

This phase also has a more pronounced focus on organisational readiness since, by the end of a Scaling project, the AI solution would be owned by the organisation into which it is deployed. Scaling therefore requires appropriate handover and change management (e.g. with end users) and mechanisms for on-going monitoring, support and improvement (from a systems perspective as well as an AI perspective). This would include monitoring AI performance from both systems/infrastructure and statistical perspectives, and then taking actions for long-term sustainability of the AI solution (for example maintaining underlying datasets or periodically re-training of models on new data). By the time that the solution is deployed, appropriate ethical and risk review and/or mitigation should also have been established. These evaluation processes will occur where the solution is deployed (e.g. at an individual member state, run by the technical team who have taken ownership of the solution) because findings might inform local adjustments. For example, an AI

algorithm may need to be fine-tuned to local nuances with respect to training data format and availability, or discrepancies in performance. However, as will be discussed in chapter 6, effort to coordinate centrally also brings benefits.

As mentioned in the overview in 5.1.1, the Scaling phase varies most significantly in the overall implementation duration. While the specifics will depend on the exact technology, people and processes associated to a given AI opportunity, an indicative illustration of the time required for scaling an AI opportunity of each complexity level is shown below:

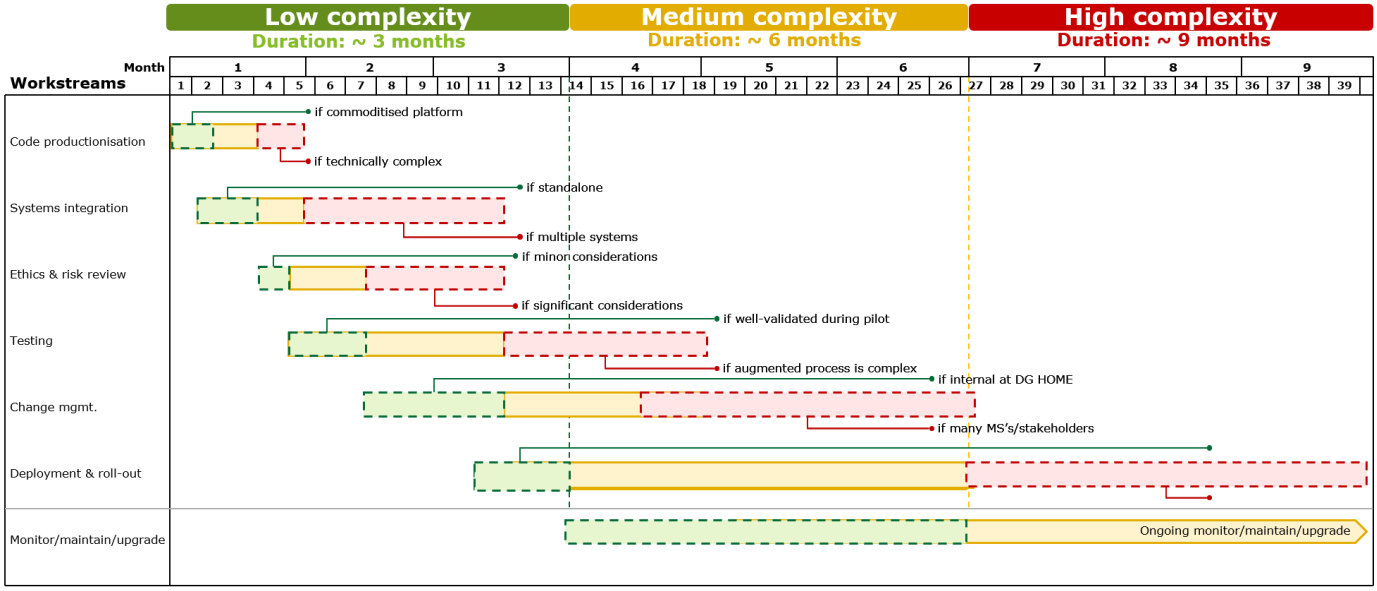

Figure 16 - Indicative Scaling timelines for different complexities of AI opportunity

This figure should be treated as a high-level indication for where time would be spent implementing AI opportunities of different complexity levels. The minimum time for scaling an AI opportunity beyond MVP stage into a full-scale roll-out would be 3 months, and this would only be possible where the AI system is relatively simple with minimal systems and stakeholders involved. On the other hand, to scale a high complexity AI opportunity beyond MVP could take up to 9 months if there are many factors to consider. This assumption is based on the idea that repeated deployments (e.g. at multiple member states) would take successively shorter times due to lessons learned. There is an indicative estimate of 6 months required for effectively replicating an initial scaling project across a wider group of stakeholders. Key factors driving this difference in time required are shown in the figure and include:

- maturity of technology (platforms vs. custom code, simple vs. complex programming logic, standalone tools vs. multiple system integrations);
- level of risk (ethical or otherwise);
- expected process impact (and hence testing requirements, and breadth and depth of change management and deployment).

Due to the potential variation during the Scaling phase, there is not necessarily a typical team structure. However, the requisite skills are similar to those outlined during PoC and MVP phases, but with a lower amount of data science and a higher amount of stakeholder and change management required.

5.1.5. Agile

Agile is the software development methodology usually followed throughout the AI development approach outlined so far in section 5.1. The philosophy of Agile is one of adaptation, flexibility and rapid evolution, whereby distinct build components are developed in distinct 'sprints' (fixed 1-2 week long periods of focused development). An Agile project rests on three pillars:

- Transparency: Progress and obstacles are regularly captured and shared with the team. In an AI project, these progress updates would initially be related to data inputs (e.g. incorporating a new dataset which was previously de-prioritised), data processing for the purpose of modelling (also called feature extraction) and prototype models which have been successfully implemented. Later, a sprint might revolve around developing and testing a more advanced machine learning model. It is relatively straightforward to establish a simple end-to-end modelling flow, but effort is then required to incorporate new data inputs, experiment with new techniques and optimise the solution.
- Assessment: New functionality is assessed on an ongoing basis. Assessment should be done with a combination of mathematical and business-oriented metrics. Mathematical evaluation should not be limited to pure accuracy but should also take into account other metrics that reveal the overall balance of model performance (e.g. precision and recall for classification tasks), and also examine performance on different archetypes of possible input. Business-orientated validation should be done by translating mathematical evaluation into real-world impacts in terms of the agreed KPIs.
- Adjustment: Requirements, plans and approach are not set in stone, they are continually adjusted. A combination of both types of assessment metric should be used to inform feature prioritisation, and the views of non-technical stakeholders should also be sought (potentially via user testing). AI development is still an experimental field and some advanced modelling may ultimately not work. While it can be worth experimenting to maximise solution performance, innovation and value generated, this type of development should generally be limited to the PoC stage.

In practice, there are more details to the Agile methodology (for example the specifics of the Scrum approach to defining and running sprints), but it is the core philosophy which is of most importance when considering AI implementation projects.

5.2. Specific considerations for different types of opportunity

The following section outlines specific considerations that should be taken into account when applying the generic implementation approaches explained in the previous section. This is because the generic approach may take a slightly different form when implementing different types of AI opportunity. Whilst the lists in this section are not necessarily exhaustive, they cover each of the main technology clusters (as defined in section 2.2.1) mapped against the individual implementation project components. In addition, opportunity-specific considerations are given where individual use cases have a particular nuance that should be kept in mind during implementation.

Various Horizon 2020 research projects are mentioned in this section. Coordination at the Commission level could bring learnings from Horizon 2020 to teams implementing related AI opportunities from this study. In addition, existing achievements from Horizon 2020 projects may be applicable to related AI opportunities (for example by providing enough validation for decision-makers to accelerate development beyond the PoC phase). Concrete collaboration opportunities with the Horizon 2020 projects mentioned in this section have not yet been explored.

5.2.1. Chatbots

The generic principles outlined in section 6.1 take on a slightly different permutation during chatbot projects. Chatbots, as a sub-field within the broad ecosystem of AI technologies, are mature and commoditised (from a technological perspective). This means that chatbot initiatives can be more readily achieved with commercially available platforms and tools, rather than necessarily through bespoke development. Whilst the philosophy of a staged, agile build approach remain consistent, there are unique considerations for the implementation of chatbots that do not appear for other types of initiative.

At their core, chatbots facilitate conversations by interpreting user input to understand their intent, generate appropriate response(s) (by consulting their own internal database of configured responses) and consider potential follow-on questions. When developing chatbots it is crucial to understand the potential input that the bot may receive, and how these inputs fit into the broader context of the conversations that it needs to handle. "Conversation flows" are representations of the possible conversations with articulations of inputs, actions that are expected, and descriptions of where the bot may need to interact further (either with the user or with other systems). Depending on the use case, conversation flows can be mapped out through the assessment of historical data, or through discussions with business experts who have understanding of the nature of discussions that the bot should handle. Chatbot conversations can often be modular in nature, consisting of discrete sections of purposeful dialogue.

Chatbots can be surfaced to users through a variety of access channels (e.g. a pop-up user interface on a website, through instant messaging platforms, or even via phone call). Additionally, chatbots can be configured to gracefully handle circumstances where they are unable to respond well, with automatic handover to human operators or by guiding the user to alternative support mechanisms.

As there are a number of commercially available chatbot platforms, minimising the need for bespoke development of core components, there is an opportunity to develop a single platform for pan-European chatbots in the context of Border Control, Migration and Security. A single platform, powered by a single vendor, can help drive development synergies across all chatbot opportunities and can aid long-term management of the technology. The selection of this vendor, and the set-up of this platform, would need to factor in certain localised differences (e.g. language support within the selected chatbot platform). This would also facilitate seamless sharing of chatbot components, which might include conversation modules, data and feedback metrics.

Table 20: Specific considerations for 'chatbot-type' AI opportunities

PoC	Design	Environment set-up	• There are many commercial chatbot development platforms, as mentioned in this study. These include open-source code frameworks, modular development platforms and managed offerings. • Historic data is not always required for chatbots; where needed, it should be extracted and processed in systems which are not yet integrated with the chatbot components, with any personal identifiers cleaned.
		Data analysis	• Training data should be checked for appropriate balance of conversation types. • The training data for most opportunities will come from internal sources. Depending on existing knowledge management processes, some 'scraping' of static content (e.g. FAQ webpages) may be required. • SISSIRENE-6 will require gathering of SIS alert forms, and appropriate encoding. • ASYLUM-11 (refugee allocation) may require gathering of statistics/reports in representative formats. • The temporal profile of historic data could be checked for trends in topics/questions.
		Requirements analysis	• At PoC stage, simpler flows with minimal data exchanges should be prioritised. Simpler interactions (e.g. static application forms, FAQ dialogues) would likely be prioritised over ones that are more complex (e.g. conditional follow-up information requests). • Downstream actions in other modules (e.g. natural language generation aspects of SISSIRENE-6, optimisation logic in OPS-5) should be restricted to core functionalities to create a well-defined scope.

PoC			• Technical evaluation metrics may include conversation durations, drop-off rates, intent classification confidence rates.
	Build	Approach	• Chatbot complexity is heavily dependent on the level of interaction with other modules and systems. • Similar solutions exist: the Finnish Immigration Service's Kamu chatbot is a virtual customer assistant that utilises artificial intelligence. Kamu is available on all pages on the migri.fi website as part of a live pilot running November 2018-2020.
		Iteration	• Data validation logic should be built and incorporated separately to core conversational flow.
		Governance	• Conversations should be checked for alignment with the associated policy/regulation/process.
	Validate	Testing	• Chatbot testing should happen in a mock scenario representative of a 'business-as-usual' situation, with initial testing by developers followed by testing with users. This can be in an internal pilot setting or as a controlled, minimal deployment to external users. A mechanism to elicit feedback would be beneficial (this can be done directly within the chatbot interface, or through other mechanisms such as a follow-up survey). However, the PoC would remain standalone without integration.
MVP		Synergies	• A way to approach chatbot development is to implement a common core functionality which is then built upon (e.g. adding additional conversation forks and APIs/data logic). This approach may be useful to extend from PoC's into more broadly functional MVPs.
		Functionality	• UI which will be external-facing (e.g. to the general public) may be created with European Commission branding. • Accessibility/usability of UI should be checked.
		Integration	• Chatbots which require more advanced data logic (such as auto-completion or adaptation of forms) will require backend database integration. • Chatbots triggering downstream models will require additional integration.
		Testing	• Providing questionnaires or user prompts during or after chatbot interactions is one way to gather user satisfaction information from a pilot cohort.
Scale		Code productionisation	• Using a commoditised chatbot development platforms would generally mean that the created solution can be packaged into a deployable format. If a more custom or open-source approach is taken, then additional considerations around code quality and API wrappers may be required.
		Integration	• Changes to integration requirements of downstream systems (e.g. for RPA) should be considered and future-proofed where possible.
		Maintenance/upgrades	• Performance metrics should be monitored. • A feedback channel can be maintained, most likely inside the chatbot itself.
		Handover	• The function of the chatbot in the process (how much it overlaps or does not overlap with human workers) should be made clear to teams. • A mechanism for catching and resolving failure cases or complaints should be established (commoditised chatbot platforms should provide a way to flag ineffectual conversations, for example those where the chatbot is not certain of a user's intent).
		Risks	• A process run through a chatbot must not discriminate against different cohorts of individuals; alignment of the overall conversational flows against existing processes and regulation should be checked, with ongoing monitoring of solution outcomes. • In situations with uncontrolled and unclean training data, chatbots can occasionally replicate profane or otherwise undesirable language, so this should be monitored and prevented.

5.2.2. Risk assessment analytics

Specific considerations for risk assessment opportunities are primarily driven by the sensitivity of the use cases and the resulting requirements around: data, appropriate evaluation of the AI, and how the solution is used in real-world processes in an ethical and trustworthy way.

In order to train AI systems to effectively aid risk assessment procedures, historic data on both individual and historic outcomes would be required. This presents distinct requirements around data privacy and potential bias that should be factored into the overall tasks for any solution development. There are frameworks in place (such as the EU AI HLEG's Ethics Guidelines for Trustworthy AI) for considering the numerous factors. What is most important is that learnings gained from executing these frameworks are

shared across the different entities involved in the development of these solutions. Discrete, targeted recommendations regarding cleansing and evaluation of certain types of data will be helpful, for example, when different member states progress to developing their own solutions in this space.

Table 21: Specific considerations for 'Risk assessment' AI opportunities

PoC	Design	Environment set-up	• Due to the custom nature of the planned solution, development would most likely occur using a common programming language like Python, R, Java, C++, etc. • Historic data for training should be extracted separately, with any personal identifiers cleaned.
		Data analysis	• To respect AI ethics guidelines, these use cases should likely retain a human expert in the loop. Providing guidance around data would be beneficial.
		Requirements analysis	• At PoC stage, and to respect AI ethics guidelines, risk assessment AI would be designed to give a sense of probabilistic elements in the risk assessment process, like threat probability or impact magnitude. Outputs could flag potential risk factors or present high-level classifications with recommended actions (as opposed to highly individualised scoring). • At PoC, it may be beneficial to scope the use case to more common types of applicant/case. • In addition to evaluating based on accuracy metrics, the internal consistency (i.e. fairness) of outputs should be checked.
	Build	Approach	• The risk assessment use cases share a common approach. They can be sequenced so that one (say VISA-3, application triaging) provides this core functionality that can be adapted for following use cases (LTSTAY-3, ETIAS-1, SCHENGEN-3, ASYLUM-7). • The Horizon 2020 programme has supported various research into ethical and regulatory questions around aspects of risk assessment (as related to opportunities in this study). For example: PROFILE[27] where a professor examined automated profiling in the context of predictive policing; and PERSONA[28] (ongoing until February 2021) looking into to design and establish unified and tailored impact assessment method to appropriately assess the effects of new "no-gate" border-controlling technologies (e.g. in terms of individual privacy, and societal and political acceptance). When implementing the AI opportunities in this study, Horizon 2020 projects such as these may provide particularly useful frameworks for addressing ethical and regulatory considerations.
		Iteration	• Adjacent modules (such as travel pattern analytics in VISA-8 and resource planning in SCHENGEN-4 and OPS-3) should be developed separately with a view to 'plug in'.
		Governance	• Risk assessment use cases are linked to more ethical considerations, so a reasonable go/no-go point may be some form of ethics and regulatory review. • To ensure compliance with regulation, maintaining a process expert in the loop would be beneficial for development.
	Validate	Testing	• In addition to mathematical evaluation metrics, the opportunities could be tested for internal usability (by e.g. a case officer). • Due to ethical implications, specific testing with so-called explainability tools (open source or Cloud based tools designed to provide interpretable explanations of AI models, for example illustrating correlations between inputs and outputs) and fairness tools (open source or Cloud based tools designed to probe AI modelling for different types of bias) may be beneficial.
MVP		Synergies	• As mentioned, risk assessment use cases may share a common core and 'plug in' to various downstream modules. • iBorderCtrl[29] (Intelligent Portable Control System) was a project aiming to enable faster and thorough land border control for TCNs. It looked at software and hardware technologies, which included for multifactor analytics and risk-based approach to process third country nationals crossing the borders of the EU, and ran pilots with the Hungarian Border Guards, the Latvian State Border Guards and the Greek Border Control and Hellenic Police officers. According to the iBorderCtrl website[30] "The pilots were successful on validating the basic concept and the lessons learned mapped further development in order to reach higher TRLs (beyond the proposal objectives)". As such, deliverables may provide insight useful for implementing various AI opportunities related to risk assessment at higher TRLs.
		Functionality	• Feedback from the PoC stage can be incorporated into UI design (e.g. to highlight perceived risk indicators, or to present on-going statistical metrics). • More granular risk classifications could be introduced.

[27] https://cordis.europa.eu/project/id/748514
[28] https://cordis.europa.eu/project/id/787123
[29] https://cordis.europa.eu/project/id/700626
[30] https://www.iborderctrl.eu/

MVP	Integration	• To extend from a PoC setting, some risk assessment use cases may require integration into live systems for real-time analytics (e.g. SCHENGEN-3, OPS-3).
	Testing	• If use cases are being deployed in a more real-time setting, stress-testing against volume of applicants/migrants and capacity of internal resources (users) may be required. This could require a sufficiently advanced testbed environment with simulated system dynamics. • If resource optimisation modules are being tested, this could be performed in a simulated environment.
Scale	Code productionisation	• Use cases deployed in real-time settings should be optimised for low latency. Depending on requirements, this may require big data processing platforms such as the Apache stack.
	Integration	• All integration should be completed.
	Maintenance/upgrades	• Solutions should be sufficiently modular so that core AI components can be upgraded in future. • Appropriate technical monitoring mechanisms should be developed, to allow for ongoing assessment of the solutions accuracy and effectiveness. For example, this may through a dashboard that tracks AI suggestion against actual human decision. • Fairness metrics should be monitored on an on-going basis, with a plan for corrective action if necessary. Similarly, ethics reviews may be beneficial.
	Handover	• Training is especially important for those use cases which may be deployed in a more real-time setting.
	Risks	• To respect AI ethics guidelines, appropriate human-centric impact assessments should be performed.

5.2.3. Knowledge management

Knowledge Management (KM) refers to the collection of use cases that relate to the use of AI technologies to understand complex data sources spread across disparate systems/sources, and enable access that is more streamlined in nature. This can involve the use of AI techniques (such as Natural Language Processing) to interpret documents that are stored in different locations, generating explanatory metadata, and then the subsequent use of advanced interfaces (such as chatbots) that can leverage this metadata to allow users to interactively surface the right knowledge stored across different systems.

The core of KM platforms is the intelligence used to scan and interpret the various data sources. Technologically this presents primarily a data engineering challenge. As more different data sources are included, there is additional time and effort required to develop AI modules that can appropriately interpret these to the degree required for more intelligent knowledge search functionality. As such, PoC functionality should be driven by the initial user search outcomes that are deemed most important, with a view to limit the data needed for initial solution development.

User interfaces for KM solutions can range in complexity. The value that these solutions bring are driven by the efficacy with which users can interactively explore and find data relevant to their needs, as such, conversational interfaces (chatbots) for Knowledge Management can bring distinct benefit as they allow search to be carried out through natural conversation. As outlined in section 5.2.1 (chatbot considerations), conversation flows are the manner in which solution scope should be thought through. For KM chatbots a similar exercise is required, where the conversation flows represent the potential ways in which a user may search the knowledge base to find relevant information for their needs.

Table 22: Specific considerations for 'Knowledge management' AI opportunities

PoC	Design	Environment set-up	• The knowledge management (KM) use cases will provide users with an interface to access organisational knowledge. It would be logical to build upon a chatbot platform (on which development would already have begun according to the roadmap timeline) as the user front-end. • To connect to data sources, it is likely that databases would be accessed with a search capability such as ElasticSearch. • Custom NLP processing would be created in a custom Python environment.
		Data analysis	• PoC should focus on extracted and cleaned (of personal identifiers but also any potentially sensitive or confidential aspects) data. For example, care should be taken not to expose any sensitive details which may exist in complete SIS forms (SISSIRENE-4, knowledge search/management tools). • The formats/types of knowledge data should be determined – for example focusing on text-based documents but omitting more unstructured formats like images at this stage. • Although appropriate scoping of data should be performed, there should be an appropriate volume of data to give the machine learning tools a chance to learn an overview of desired content.
		Requirements analysis	• Knowledge search should be scoped to a particular set of search outcomes (typical search queries or common processes such as finding an appropriate SIS form). • Technical performance metrics could include number of hits on a search, potentially assessed against existing metadata methods if these exist (e.g. pre-tagged documents).
	Build	Approach	• As mentioned, semantic search capabilities (searching based on natural language) can be developed from existing chatbot opportunities. • CROSS-7 (historic case reasoning) can be considered a KM use case as it will also search through historic documents. Due to its complexity, learning from other KM use cases would be a recommended first step.
		Iteration	• Additional NLP functionalities (like auto-complete of search queries) should be incorporated iteratively into a core engine (e.g. chatbot base). • Developing NLP functionalities for content tagging could inform other NLP-based use cases in the area of policy analytics (for example feeding into a topic modelling approach).
		Governance	• A combination of NLP and domain knowledge specialist skills would be required for tool development and testing.
	Validate	Testing	• Based on the requirements analysis, the tool should be tested to see if it can deliver desired outcomes. • Having more inexperienced end users use the tool would provide a sense of robustness (an inexperienced user would have less ability to recognise whether a desired piece of knowledge was missing from search results, for example). • Observation of frequent searches would provide learnings, for example implying functional additions which should be incorporated during an MVP phase.
MVP		Synergies	• As mentioned, there are overlaps with chatbot use cases in terms of the core user interface (building from e.g. CROSS-23). • Once SISSIRENE-4 (knowledge search/management tools) is developed to search SIS databases, it may inform an approach to SISSIRENE-6 for filling in SIS forms. • The ability of ASYLUM-14 (intelligent search engine) to perform structured searching through migration context data may provide a link to CROSS-7 in terms of finding common migration cases.
		Functionality	• More advanced functionality around Natural Language Generation can be explored – for generating credibility questions based on COO information in ASYLUM-14 (intelligent search engine) (and for completing forms in SISSIRENE-6).
		Integration	• As mentioned in Synergies, the development of SISSIRENE-4 (knowledge search/management tools) may inform SISSIRENE-6 (in terms of connection to the SIS database).
		Testing	• MVP testing should be broader in scope that PoC testing, potentially targeting more outcomes or dealing with a broader set of knowledge data. • Testing a tool for knowledge search across multiple member states could provide valuable insights. For example, it might uncover national variation in the types of data used for credibility questions during migration interviews.
Scale		Code productionisation	• Further to established technologies like chatbot platforms and ElasticSearch (or similar), more advanced and custom functionality (such as NLP or Natural Language Generation (NLG)) would likely be incorporated in some form of API connected to the core engine of the solution(s).
		Integration	• Integration into existing operational tools can be explored: for example into systems used before/during asylum interviews to generate Country of Origin Information (COI) credibility questions (ASYLUM-14, intelligent search engine).
		Maintenance/upgrades	• Solutions should be deployed with an operational feedback loop, to ensure appropriate performance and ability to improve. For example, knowledge search tools could present options for users to manually add or correct metadata tags. As with other chatbots, solutions which use these interfaces can also maintain a feedback channel (such as by asking for user feedback at the end of a conversation/session). • In future, more advanced NLP models (for example future public or custom pre-trained embedding models) may enhance solution performance. There is a trend in NLP for research organisations like Google and Microsoft to release ever-growing variants of these kinds of models.

Scale			• Appropriate technical monitoring mechanisms should be developed, to allow for ongoing assessment of the solutions accuracy and effectiveness. For example, this may through a dashboard that tracks user feedback.
		Handover	• To assist with a smooth handover, the functionality and limitations of these tools should be explained to end users. • Users often learn the quirks of search tools (for example searching with targeted keywords and modifying symbols like quote marks when using Google web search). A more technical explanation of these AI solutions may enable users to optimise their own workflow in a similar fashion.
		Risks	• Appropriate fairness testing around generation of COO credibility questions should be performed (ASYLUM-14, intelligent search engine).

5.2.4. Policy insight/analytics

Policy analytics opportunities are (in this study) fundamentally about the application of Natural Language Processing to interpret text data sources that are relevant to various aspects of the policy making and enforcement process. Achieving functional solutions for the opportunities within this category can involve a mixture of bespoke components, cloud components, and/or commercial tools.

Table 23: Specific considerations for 'NLP-type' AI opportunities

PoC	Design	Environment set-up	• POLICY-2 and POLICY-5 are expected to run from the Deloitte RegExplorer solution. • Other use cases would most likely be developed in custom Python environments, with light integration into simple databases (SQL or pre-existing). • POLICY-8 is designed to perform external information gathering and so may benefit from deployment in a Cloud-based environment.
		Data analysis	• Some of the tools may benefit from higher volumes of data (e.g. POLICY-5 to generate clusters) while others should be appropriately restricted in scope for PoC phase (e.g. applying POLICY-12 to predict sentiment signals in only a certain, non-sensitive domain of policy).
		Requirements analysis	• For PoC level, core functionalities are targeted: direct (and indirect) links in POLICY-2, a preliminary view of clusters for exploration in POLICY-5, a set of gathered and simplistically tagged articles (for example) in POLICY-8, a set of visualisation techniques and a light version of the 'communication report structuring' functionality in POLICY-9, and high level sentiment predictions (e.g. positive, negative, neutral) in POLICY-12. • Technical performance metrics might include: correct matches (based on tags or other codified policy links), confidence scores (for clustering or sentiment), a sense of explainability power (POLICY-9).
	Build	Approach	• Excluding POLICY-2 and POLICY-5, solutions can develop from existing chatbot and KM use cases (by leveraging similar NLP functionalities around entity recognition, auto-completion etc.). • For external data gathering capabilities in POLICY-8, appropriate consideration should be placed on terms and conditions which external sources may have around API access or web-scraping. • The Real-time Early Detection and Alert System (RED-Alert)[31] project is developing a solution for augmenting social media intelligence (SOCMINT) with AI techniques for the purposes of law enforcement and counter-terrorism. It is developing novel natural language processing (NLP), semantic media analysis (SMA), social network analysis (SNA), Complex Event Processing (CEP) and artificial intelligence (AI) technologies; in the context of social media data analytics, transforming (unstructured) social media data into (structured) events enhanced by semantic attributes. These approaches may be similar in nature (at least enough to provide relevant technical learnings) to the text analytics initiatives related to Policy insight/analytics, especially more advanced opportunities like POLICY-8 (external newsgathering) and POLICY-12 (predicting policy acceptance).
		Iteration	• For POLICY-9, there is a core hypothesis for validation which is that the AI-driven approach will create more compelling and informative communications. • For POLICY-2 and POLICY-5, an initial RegExplorer-based development could be followed by the option to 'bolt-on' additional and more custom functionalities.
		Governance	• A combination of NLP and policy knowledge (subject matter, target audiences etc.) would be required during development.
	Validate	Testing	• Testing can be at a technical level to ascertain the accuracy of policy analytics (e.g. "did the tool find all related regulations?"). • Testing can also be more outcome-focused, for example gauging the usefulness of an AI solution when used to answer a policy-driven question (e.g. "how has policy in a certain domain evolved over time?").

[31] http://redalertproject.eu/

MVP		Synergies	• Building POLICY-5 and POLICY-8 first may then inform POLICY-9 and POLICY-12, since an understanding of policy substance (given by clusters and tagging) may inform approaches to policy communication and sentiment/response analytics. • Techniques from use cases like SISSIRENE-4 (knowledge search/management tools) and ASYLUM-14 (intelligent search engine), which will require NLP-based understanding of text data, may be incorporated.
		Functionality	• Based on PoC user testing, a more concrete user interface(s) might be developed at this stage (for example a custom web-based browser front-end). • Underlying NLP models (e.g. for entity recognition) might be fine-tuned on policy documents, especially if PoC development has unlocked the ability to generate tagged training data.
		Integration	• POLICY-2 and POLICY-5 may require some form of integration into existing policy databases (e.g. the EUR-Lex database).
		Testing	• POLICY-12 might be back-tested on historic policy debates or prior engagements with the public where a sense of sentiment response was able to be ascertained.
Scale		Code productionisation	• For the more custom, Python-based models, it is likely that API wrappers would need to be created.
		Integration	• Potential future integrations would include access to wider policy-related information sources (such as secondary statistics which are used to inform policy context or public response assessment).
		Maintenance/upgrades	• Particular care should be given to the performance of solutions as related to major policy developments, with learnings captured and incorporated into future development.
		Handover	• The strengths and limitations of the tools should be clearly communicated. • A more technical explanation of the AI solutions may instil trust in the user and enable them to optimise their own workflow when using the tools.
		Risks	• Appropriate validation of externally gathered data should be in place. • Appropriate considerations of the legitimacy of predicted sentiment response to policy making should be taken.

5.2.5. Computer vision

Computer vision opportunities encapsulate a variety of opportunities, all related to the use of AI on image data. There are certain opportunities within this space (e.g. Optical Character Recognition) where the technology is comparatively mature and there is the opportunity to effectively use commercially available options. In these cases, it may be beneficial to agree a platform/tool of choice which can be used by numerous entities.

For other opportunities where bespoke development of AI models is required, beyond the considerations noted in the guidance below, it is worth factoring that this sub-field is rapidly expanding in capability and offering. In the near future, capabilities of commercial vendors and the effectiveness of open source options may change the development approach required for efficient delivery of these opportunities. In the context of the roadmap, computer vision opportunities have been positioned later in the overall timeline, primarily due to the complexity but also to offer flexibility in development approach, should offerings change in the near future.

Table 24: Specific considerations for 'Computer vision' AI opportunities

PoC	Design	Environment set-up	• As mentioned in the first report of this study, computer vision technologies are relatively well-established on the major Cloud platforms, so a Cloud-based approach may be suitable. • Alternatively, on premise computer vision solutions do exist, either as licensable software or free-to-use open source packages. • Depending on the complexity of the use case, and initial effectiveness of the use case, it may be required to develop bespoke AI models for computer vision. This would require custom development in a programming language of choice (e.g. Python, C++, Java etc.). Note that this custom AI development may operate as a subsequent "layer" of processing, following the outputs from other solutions (e.g. Cloud-based offerings).
		Data analysis	• For PoC, it is most suitable to use dummy data (i.e. generic examples of European vehicle registration plates and public face datasets (potentially synthesised)), provided these are representative of the desired use cases. • To augment model training data, a set of cross-cutting data augmentation techniques could be implemented (to do things like adding random noise to training examples, to increase trained model robustness).
		Requirements analysis	• PoC's should be suitably scoped in terms of desired outputs: addressing certain types of SIS alerts (e.g. vehicle matches for SISSIRENE-1), certain demographics

PoC			(ASYLUM-3, vulnerability assessment), certain types of documents or fraud techniques (CROSS-12 and CROSS-6), certain types of biometric (CROSS-25). • Outputs should be similarly well-defined, for example: simple object detection for SIS alerts (SISSIRENE-1), simple classification of faces into key categories (such as 'potential issues detected' vs. 'no concern') (ASYLUM-3, vulnerability assessment), binary classification of documents as fraudulent or not (CROSS-12 and CROSS-6). • Similarly, the deployment options of SISSIRENE-1 (alert detection) should be considered in terms of desired latency and breadth of targeting (e.g. at high traffic events vs. continuous monitoring).
	Build	Approach	• While each computer vision opportunity is fairly standalone, there are some common functionalities which might be developed as a shared functionality: optical character recognition (OCR; to apply to various documents), facial recognition analytics and object detection. These could either be Cloud APIs or more custom developments. • Pre-trained models might be fine-tuned on domain-specific data (for example facial recognition to the style of images that would be accessible during the operational process around the solution). • The Biometrics Evaluation and Testing[32] (BEAT) project's aim was to build an online and open platform to transparently evaluate biometric systems, designing protocols and tools for vulnerability analysis and developing standardization documents for Common Criteria evaluations. iBorderCtrl[33] (Intelligent Portable Control System) was a project aiming to enable faster and thorough land border control for TCNs. It looked at software and hardware technologies, which included for biometric verification, and ran pilots with the Hungarian Border Guards, the Latvian State Border Guards and the Greek Border Control and Hellenic Police officers. According to the iBorderCtrl website[34] "The pilots were successful on validating the basic concept and the lessons learned mapped further development in order to reach higher TRLs (beyond the proposal objectives)". As such, deliverables from these Horizon 2020 projects may provide insight useful for implementing CROSS-25 (biometric matching) in particular. • The D4FLY[35] project (ongoing until August 2022) will augment the current capabilities and capacities of border authorities in countering emerging threats in document and identity verification (e.g., forged documents, impostor fraud, morphed faces) at manual and highly automated border control points and in the issuance process of genuine documents. Technical learnings from this project are expected to be highly applicable to CROSS-6 and CROSS-12 for fraudulent document analysis.
		Iteration	• The tools could be iteratively expanded to deal with wider document types (etc.). • For SISSIRENE-1 (alert detection), it would most likely be easier to begin with detecting vehicles and expand to people and other objects.
		Governance	• Local expertise will be required to inform and assess document fraud analytics. • Vulnerability (for special procedural guarantees) experts such as social care workers would be required for ASYLUM-3 (vulnerability assessment).
	Validate	Testing	• In addition to core accuracy metrics, these use cases should be assessed from the perspective of operational impact (for example, with respect to a SIS alert false positive). This could occur in a pilot setting (probably during MVP not PoC) or via business simulation. • The usability of tools should also be assessed, for example whether ASYLUM-3 (vulnerability assessment) could be deployed in real-time or whether it would require separate analysis of captured photo or video data.
MVP		Synergies	• CROSS-6 and CROSS-12 are very similar in approach, but applied to different documents. • CROSS-6 and CROSS-12, as well as SISSIRENE-1 (alert detection), would all leverage some form of OCR. • ASYLUM-3 (vulnerability assessment) and CROSS-25 may use similar facial recognition/analytics functionalities.
		Functionality	• Models should be optimised, potentially via fine-tuning on real data or labelled examples. • Explainable AI (XAI) techniques could potentially be incorporated to provide additional output information and a better sense of confidence in the solutions (for example, image heatmaps to identify which aspects of image data led to a prediction being made by the AI).
		Integration	• CROSS-12 may need integration into border systems for real-time deployment. • SISSIRENE-1 (alert detection) may require integration into SIS systems for real-time alerting ability.
		Testing	• In addition to mathematical accuracy testing, tools should be tested from a usability perspective; for example, checking whether border guards are able to use a tool like CROSS-12 if it is deployed in real-time at the border. • Post-hoc fairness assessments of results should be performed.

[32] https://cordis.europa.eu/project/id/284989
[33] https://cordis.europa.eu/project/id/700626
[34] https://www.iborderctrl.eu/
[35] https://cordis.europa.eu/project/id/833704

Scale		Code productionisation	• Some form of API wrappers may be required.
		Integration	• Downstream reporting integrations may be required for accountability purposes.
		Maintenance/upgrades	• Computer vision models should be developed in a modular fashion to allow for future upgrading (e.g. more advanced pre-trained models). • Appropriate technical monitoring mechanisms should be developed, to allow for ongoing assessment of the solutions accuracy and effectiveness
		Handover	• Appropriate training, especially for those computer vision solutions designed for real-time deployment, should be provided.
		Risks	• Facial recognition is a commonly debated topic in the world of AI, and these use cases, especially ASYLUM-3 (vulnerability assessment), require significant oversight.

5.2.6. Other

The remaining opportunities in this roadmap are uncategorised, with specific observations provided below.

Table 25: Specific considerations for generic AI opportunities

PoC	Design	Environment set-up	• Due to the bespoke nature of these opportunities, development would most likely be a custom Python environment. However, more suitable 3rd party platforms may well have been developed by this point in the implementation roadmap.
		Data analysis	• The cross-cutting nature of these use cases implies a need for lots of data extracts (historic migration cases for CROSS-7 and other AI performance data for CROSS-8). While the usual approach would be to use (cleaned) extracts, it may be beneficial to address integration requirements at an earlier stage for these PoC's, to reduce the burden on data gathering.
		Requirements analysis	• For CROSS-7, an appropriate level of outputs should be decided (ranging from locating similar historic cases, to flagging key data elements/outliers, to recommending decisions). • For CROSS-8, PoC would most likely focus on synthesis and presentation of fairness metrics and related indicators.
	Build	Approach	• CROSS-7 would most likely combine statistical analysis with machine learning techniques for comparison (e.g. doc2vec models) alongside expert rules. • CROSS-8 would most likely perform statistical analysis using approaches specifically designed to assess other AI models, but could also incorporate expert rules to look for specific problematic edge cases, for example.
		Iteration	• For CROSS-7 to ascertain similarity of cases, a range of approaches could be developed iteratively, ranging from commonality of input data and shared outcome decisions to similar macro-level context (e.g. migrants travelling from different locations but both under conflict) and shared observed discrepancies (e.g. migrants who both fall into statistically unlikely outcome categories). • Analysis in CROSS-8 might be applied iteratively to different AI solutions.
		Governance	• Due to the cross-cutting nature of these opportunities, appropriate governance processes should be in place. For example, CROSS-8 might be owned by an individual with oversight over other AI development initiatives.
	Validate	Testing	• Testing of CROSS-7 could be performed with case officers who have sufficient experience to evaluate the solution outputs. • Testing of CROSS-8 could be performed at both the statistical analysis level, but also in terms of business implications of any potential identified errors (e.g. what is the business implication of letting an AI model continue to behave as it does vs. applying some form of adjustment?).
MVP		Synergies	• Both use cases are cross-cutting by nature and should be developed after other AI opportunities have been developed. • The ability of ASYLUM-14 (intelligent search engine) to perform structured searching through migration context data may provide a link to CROSS-7 in terms of finding common migration cases.
		Functionality	• User interfaces which are simple to use and understand should be developed.
		Integration	• Any integrations into case databases or other AI models, not performed during PoC stage(s), can be performed here. • This may leverage on future work around systems interoperability.
		Testing	• The testing applied at PoC level should be applied to any additional case databases or AI model that were incorporated during MVP.

Scale	Code productionisation	• Code should be deployed in a way which is complementary to future AI development, for example using APIs and pre-processing of AI model results (as opposed to directly integrating into the base AI models under evaluation by CROSS-8).
	Integration	• Depending on requirements, integration might include a real-time or recurring processing schedule. Real-time would be more suitable if case reasoning and AI assessment are considered 'mission critical', whereas recurring/batch processing would be more suitable if CROSS-7 and CROSS-8 are considered reporting or QA tools.
	Maintenance/upgrades	• Sufficient knowledge of the analysis performed by CROSS-7 and CROSS-8, as well as of the related case assessment processes and AI models under evaluation, would be required to make informed decisions about maintenance and upgrading.
	Handover	• Tools should most likely be deployed in a central AI function, to maintain suitable technical oversight.
	Risks	• While CROSS-8 is targeting ethical outcomes by design, the cross-cutting nature of these opportunities means that appropriate ethical oversight should be sought. • The technical complexity of these proposed solutions may pose a risk to organisational acceptance and on-going development.

5.3. Specific considerations for the initiatives

The purpose of the following section is to comment on the particular resourcing profiles required to implement each initiative. It combines observations from previous sections, namely the sequencing rationale (section 4.2), specific considerations based on different opportunity types (section 5.2) and scaling complexities (section 5.1). To avoid duplication, only the most relevant points are made here and these should be treated as high-level guidance for resourcing and running the implementation projects defined by the roadmap.

5.3.1. Initiative 1: Visa issuance for short stay

There are two main considerations for this initiative. As expanded upon in section 4.2.1, there is potential synergy with the visa digitalisation work running at DG HOME in 2020-21, so work in this initiative should involve shared resources or collaboration between teams. Secondly, opportunities towards the start of this initiative are key for the cross-initiative knowledge sharing that can drive efficiency and results during the roadmap's first wave of opportunities (for more details see section 4.2.2), in particular with VISA-1 (application chatbot) and VISA-9 (tailored application form). However, due to eventual deployment at individual member states, resourcing should seek to balance local variation (of requirements, technology, data, etc.) against the objective of a harmonised approach to migration.

Regarding individual resources working on implementation projects in this initiative:

- Data scientist(s) working on VISA-1 (application chatbot) and VISA-9 (tailored application form) should seek to leverage central resources as much as possible, for example by working at DG HOME alongside visa digitalisation work, or by sharing technology in a Centre of Excellence (see chapter 7). For MVP and Scaling, it may be suitable to deploy member state specific resources to handle any variation. After deployment, these resources would then be responsible for any periodic re-training of models based on new local data. This might involve liaison with the visa digitalisation work to understand updates to data models and formats.
- To facilitate combining VISA-8 (identification of irregular travelling patterns) and VISA-3 (application triaging) together, projects would benefit from a shared pool of data science and data engineering resources (for example staffed at DG HOME during PoC development and then extended out to member states for MVP and Scaling).
- Business analysts or policy officers from DG HOME can work on the requirements analysis and design work in this initiative, alongside visa digitalisation work. For MVP and Scaling, there may be business analysis activities required at individual member states.

- Project management should ensure coordination with visa digitalisation and related AI initiatives in this roadmap. To maintain appropriate oversight, this should be handled at DG HOME / Commission level (with individual project managers potentially required for MVP and Scaling across multiple member states).

The complexity framework, as outlined in section 5.1, defines the durations of individual implementation projects. Most notable in this initiative are the high complexity opportunities which would demand more resource effort. In particular, VISA-9 (tailored application form) and VISA-3 (application triaging) are marked as the highest complexity whereas VISA-1 (application chatbot) is seen as more straightforward (and can benefit from related parallel projects in the roadmap – see section 4.2.2).

5.3.2. Initiative 2: Issuing ETIAS travel authorisation

There are two main considerations for this initiative: the ETIAS system implementation timeline (in 2022), and the notion that this initiative follows Initiative 1 (Visa issuance for short stay) in order to benefit from opportunity development synergies.

- The data science and engineering resources required in this initiative can be simply divided between the two opportunities – with ETIAS-4 (application chatbot) requiring chatbot expertise and ETIAS-1 (risk assessment) requiring Risk Assessment expertise (see 5.2 for specific guidance related to developing different types of AI opportunities). These could be staffed at the relevant agencies, for example the ETIAS Central Unit or eu-LISA. Given the link to opportunities in Initiative 1, synergies may be maximised by supporting these resources with learnings from a central perspective (either via CoE – see chapter 6 – or DG HOME resource support).
- To scale these opportunities across different ETIAS National Units, data engineering resources may need to be deployed at each (depending on the level of adaptation required).
- Business analysts may similarly need to understand potential variation at ETIAS National Units.
- Project management should interface with the CoE or central DG HOME resources in order to ensure that overlaps with Initiative 1 are available and leveraged.

ETIAS-1 (risk assessment) received lower feasibility scores during the first part of this study and is hence placed onto the roadmap with a longer duration (due to a high complexity score). Part of this longer duration would likely involve risk/ethics review of the tool to ensure appropriate usage (see 5.1.3), and change management work if deployment is to be performed separately at different ETIAS National Units. Following deployment, on-going liaison between National Units and a central AI CoE can provide the option for periodic risk/ethics reviews and resource training.

5.3.3. Initiative 3: Issuance of docs for long-stay or residence in the Schengen Area

As with the previous two initiatives, Initiative 3 begins with a chatbot development (LTSTAY-1), before it moves to risk assessment (LTSTAY-3 – triaging of application). The later opportunity (LTSTAY-9,moving within the Schengen area)) is placed later due to expected regulatory requirements. Like in Initiative 1, deployment would be at individual member states so resourcing decisions should drive a balance between local expertise and central coordination.

- A combination of data scientists with experience in chatbots and risk assessment (e.g. with strong statistical analysis skills) would be required at various points in this initiative – see section 5.2 for specific guidance around implementation of different types of AI opportunities. While PoC's could be developed centrally (e.g. at DG HOME), deployment at individual member states may require local resourcing.

- Similarly, local data engineering and business analysis work may be required at individual member states to implement tools in MVP and Scaling phases.
- There would be additional business analysis requirements for LTSTAY-9 (moving within the Schengen area) in terms of defining the regulatory requirements. This would be handled centrally at DG HOME.
- Project management should coordinate overlap with chatbot and risk assessment opportunities found elsewhere in this roadmap, plus provide the necessary direction for the regulatory work on LTSTAY-9 (potentially coordinating with a central CoE for guidance – see chapter 7). Similarly, efforts should be made to coordinate on-going updates to AI models following deployment. For example, chatbot conversation logs could be aggregated and analysed, alongside the regulatory perspective, to understand if programmed conversation are meeting user needs, or whether (and how) the scope could be adjusted.

The LTSTAY-3 (application triaging) opportunity is expected to benefit from synergies (see section 4.2.2) so has a medium expected duration even though it is seen as high complexity project. As mentioned, LTSTAY-9 (support moving within the Schengen area) is expected to take longer due to the regulatory work necessary to enable implementation.

5.3.4. Initiative 4: Granting International protection

This initiative again starts with chatbot development, before moving into various other opportunity types (including knowledge management, risk assessment, computer vision). Most use cases are central in nature – developing them from a common platform will further the aim of achieving a common approach to migration (even if AI solutions are then deployed by national authorities and used by local case officers). To ensure this, engagement with EASO throughout the initiative would also be beneficial.

- Effort should be made to maximise the synergistic overlap between ASYLUM-5 (registration chatbot) and ASYLUM-14 (intelligent search engine), for example by using a pool of data scientists well-versed in different aspects of Natural Language Processing (NLP) (for details, see 4.2.1).
- Opportunities placed later in this initiative, for example ASYLUM-3 (vulnerability assessment), are expected to be particularly complex (reflected in the extended durations) and would hence require particularly capable data science resources. On an on-going basis, these resources may benefit from experimenting with building the most recent state-of-the-art techniques into the AI models (to optimise performance).
- Similar points around NLP capabilities are true for data engineers. In addition, deployment to individual member states (for example national migration authorities) at MVP or Scaling phases may require local resourcing of data engineers.
- Similarly, business analysis may be required to understanding potential member state variation (in terms of requirements, technology, data, etc.), potentially via local resourcing. This may be particularly true for ASYLUM-11 (refugee allocation) due to political sensitivities.
- Project management should coordinate overlap with other AI opportunities in this roadmap, potentially via a central CoE (see chapter 6). A project manager should also manage stakeholder engagement with EASO. This role would occur at a central level (e.g. DG HOME) but some local project management may be required for deployment (e.g. to coordinate local business analysis work). Following deployment, a central resource might focus on coordinating risk/ethics oversight (given the potentially sensitive nature of this initiative domain).

The AI opportunities coming later in this initiative are of higher complexity and hence are expected to take more time to implement. ASYLUM-11 (refugee allocation) may pose more of a data gathering/processing challenge (which might necessitate more work during the Design phase), while ASYLUM-7 (abscondment risk assessment) and ASYLUM-3 (vulnerability assessment) pose more modelling challenges (which might

necessitate more work for data scientists during Build phases, as well as ethics/risk reviews with guidance from a central body like EASO or an AI CoE) – see section 5.2 for specific comments on these AI opportunities.

5.3.5. Initiative 5: Consultation of SIS and involvement of the SIRENE Bureaux

Initiative 5 comes later in the overall roadmap than the previous initiatives. Some of the exact deployment configurations of solutions are to be determined during scoping and PoC work (for example the scope of SISSIRENE-1 (alert detection) – see section 5.2.5). These decisions could influence the resourcing requirements of implementation projects.

- Data scientist(s) working on SISSIRENE-4 (knowledge search/management tools) should collaborate with the other KM use case in the roadmap (ASYLUM-14, intelligent search engine) – see section 4.2 for more details.
- If AI opportunities are to be deployed at different SIRENE Bureaux then, depending on the level of local variation (in terms of data, technology, etc.), local resourcing may be required. On an on-going basis, there is the potential for local resources to investigate adapting AI to their specific national security context (for example fine-tuning a computer vision model to optimise detection of a certain type of vehicle).
- Scaling and roll-out of the AI opportunities could either be 'bottom-up' or 'top-down' in nature: with ad hoc local uptake by individual member state SIRENE Bureaux, or a mandated cascade out from a central authority (e.g. eu-LISA). Business analysis would be required to understand these scenarios and any differing requirements, which would most likely involve a combination of local input and central coordination. During and following deployment, resources to maintain and extend the technical infrastructure supporting these use cases may be required (for example to upgrade computer vision functionalities from batch to real-time processing).
- Project management would be required to facilitate this coordination across member states / SIRENE Bureaux and other related bodies which might include eu-LISA or an AI CoE at DG HOME responsible for driving uptake.

SISSIRENE-1 (alert detection) is given a higher complexity rating and hence longer duration, due to expected technical modelling difficulty (which would necessitate more data science work) and the aforementioned deployment landscape challenges (which may necessitate more business analysis and data engineering work).

5.3.6. Initiative 6: Border checks at the external Schengen borders

The two opportunities which comprise Initiative 6 can be treated as completely distinct projects as they are placed separately in the overall roadmap.

- Data scientist(s) would be expected to create core solutions with at most a pilot selection of member states, and then scale out across individual member states.
- Data engineering work would similarly focus on a core solution, and may then require local resourcing to scale out across individual member states.
- Business analysis would be required to understand different member state requirements during MVP and Scaling phases. On an on-going basis, this could potential adapt to national security contexts (which may then involve local data science resources working to fine-tune AI models by re-training them on more relevant or updated data).

- Project management would be required to coordinate work across multiple member states, in addition to leveraging learning around risk assessment work (potentially via a CoE at DG HOME) for SCHENGEN-3 (see section 5.2.2 for more details).

Both individual opportunities are seen as relatively complex (due to the potential for multiple member state deployments), so are marked with high complexity and duration.

There are various Horizon 2020 projects which are particularly relevant for this initiative, and may provide opportunity to leverage existing research and innovation. The BOrdDErGuArd[36] (BODEGA) project's aim was to develop future border checks with human factors expertise in order to enhance efficiency, border security and traveller satisfaction. The project investigated and modelled Human Factors in border control to provide innovative socio-technical solutions for enhancing border guards' performance of critical tasks, support border management decision-making, and optimise travellers' border crossing experience. Deliverables include recommendations and specifications on: background data for risk analytics, requirements for future smart borders focusing on human factor, and a Decision Support System (DSS) that enables border guard practitioners to assess the potential impact of implementing new solutions for Smart Borders. These deliverables may provide particularly useful guidance for deploying and scaling AI opportunities.

There are also various research projects completed under Horizon 2020 and related to technology for faster, secure and mobile border crossing points, which is not an area of particular focus in this initiative but may nonetheless provide useful related guidance. These include:

- MobilePass[37] which demonstrated and evaluated a mobile border system in two member states;
- XP-DITE[38] which developed, demonstrated and validated a comprehensive, passenger centred approach to the design and evaluation of integrated security checkpoints (CPs) at airports;
- FastPass[39] which established and demonstrated a harmonized, modular approach for Automated Border Control (ABC) gates;
- SMart mobILity at the European land borders[40] (SMILE) (ongoing until June 2020) which leverages the capabilities of the smart mobile devices in biometric control for secure and trusted authentication, and elaborates on their exploitation as part of a multimodal biometric verification process, for the accurate verification, automated control, monitoring and optimization of people' flows at Land Border Infrastructures.

5.3.7. Initiative 7: Operational management of services at eu-LISA

Each opportunity in this initiative is for internal deployment at eu-LISA, so development should take place with this agency (using a combination of eu-LISA resources, DG HOME support and other outsourced support as appropriate).

- Although development would occur at eu-LISA, effort should be made so that data scientists can learn from ongoing chatbot development work elsewhere in the roadmap (see 4.2.2). This could involve a central 'core' of chatbot functionality developed centrally at an AI CoE (see chapter 6) and then adapted for eu-LISA, for example (see 5.2.1).
- Data engineering work may require input from eu-LISA resources as these are expected to have specialist knowledge related to the systems in scope for this initiative.

[36] https://cordis.europa.eu/project/id/653676
[37] https://cordis.europa.eu/project/id/608016
[38] https://cordis.europa.eu/project/id/285311
[39] https://cordis.europa.eu/project/id/312583
[40] https://cordis.europa.eu/project/id/740931

- Project management should facilitate the coordination with other chatbot developments.

Due to the limited stakeholder base and relatively straightforward use cases, the durations of projects in this initiative are generally lower than in other initiatives and would follow the conventional approach as outlined in section 5.1. Once deployed at eu-LISA, each AI might be assigned to a 'product owner' with responsibility for on-going operational usage

5.3.8. Initiative 8: EU policy making and enforcement process

Each opportunity in this initiative is for internal deployment at DG HOME, so development should occur there (either with DG HOME resources, potentially as part of an AI CoE, or using other outsourced support as appropriate).

- Data scientists involved in this initiative should have expertise with NLP (Natural Language Processing) since this initiative sees a general trend of increasingly complex NLP-focused use cases being implemented. Aspects of opportunities may be complementary (for example, suitable for code re-use) so efficiency may be gained from re-using the same data science resources throughout the initiative. Data scientists and data engineers might be utilised following deployment to bring in additional data sources to the AI models, or to re-train and upgrade models (given that research currently creates new state-of-the-art NLP models at relatively high frequency).
- There are potentially risk and ethics considerations to be addressed by business analysis activities in this initiative, especially for opportunities which come later (see section 4.2.1).
- Multi-lingual resources may be beneficial.
- Project management should ensure coordination with related NLP or KM (Knowledge Management) work (see section 5.2.4 for details).

POLICY-8 (automated news-gathering) is seen as requiring the longest individual implementation due to the potential wide scope of data sources and consequentially for data processing and analysis/modelling. The initiative as a whole can be viewed as a set of closely related opportunities growing in ambition. Therefore there may be opportunity to adjust the specific sequencing and placement of activities in the roadmap depending on the operating context of DG HOME at the time. Nonetheless, care should be taken to maintain the synergies with the wider roadmap (see section 4.2.2). Once deployed at DG HOME, each AI might be assigned to a 'product owner' with responsibility for on-going usage (for example, having a team to trigger an appropriate response where AI has noticed an apparent lack of compliance around the national transposition of directives).

5.3.9. Initiative 9: Transversal processes and stakeholder opportunities

By nature of this initiative, there is a lot of overlap with other processes and initiatives. Therefore, effort should be made to maximise the amount of resources coming from a central body (DG HOME / Commission, potentially resources staffed specifically at an AI CoE). Furthermore, opportunities should be recognised as relatively ambitious and requiring strong technical expertise.

- CROSS-23 (general EU chatbot) is positioned first as a 'general' chatbot. As repeatedly noted (e.g. in sections 4.2.2 and 5.2.1), there is possibility to re-use a 'core' chatbot functionality when developing other use cases. As such, the data scientists responsible for developing CROSS-23 (general EU chatbot) should be particularly competent at chatbot development.
- Similarly, the data scientist responsible for developing opportunities CROSS-12 (forged travel document detection), CROSS-6 (forged supporting docs detection) and CROSS-25 (biometric matching) should have strong computer vision skills (see section 5.2.5 for further details).

- At the start of the initiative, there is not a huge data engineering requirement. However, strong skills would be required for creating highly transversal pipelines (e.g. in CROSS-7 historical case reasoning and CROSS-8 ethical monitoring, which may tap into multiple AI systems).
- This initiative should be run with central resources.
- The project manager(s) involved should maintain coordination between transversal opportunities and each of the other initiatives (where relevant).
- If the business analysts and/or policy officers involved in this initiative are part of a central AI CoE, then it may be logical for the same individuals to become involved in shaping the direction of the CoE beyond this roadmap. This is because they would be most involved towards the end of the roadmap (where this initiative is placed) when the CoE role could evolve. Individuals involved in the Transversal initiative should be well-placed to understand the broad landscape of requirements related to AI implementation projects, and hence to understand what value the CoE can continue to bring.

In terms of duration, the initiative ramps-up towards the end of the roadmap. This is where various high complexity projects are scheduled to run in parallel, so may require a corresponding ramp-up of central resourcing from DG HOME for this AI initiative.

6 Enabling activities

To maximise the chance of successful implementation at the programme-level (i.e. spanning multiple initiatives), it is important that efforts are made to leverage potential synergies (which may be related to people, processes or technology). Moreover, there are a number of prerequisites for launching or finalising the development of an opportunity. This chapter discusses the relevant enabling initiatives and governance required to achieve the objectives of the roadmap successfully. The specific context of the European Union has an impact on how those enablers should be set-up. Indeed, depending on the type of stakeholder involved (the Commission, member states or agencies), implementing the aforementioned opportunities can require different type of capabilities, processes or infrastructure.

While there may be differences between stakeholders, there are also commonalities. In general, all efforts to implement AI sit underneath the over-arching European AI strategy and coordinated action plan, set out by the European Commission. Therefore, implementation should be viewed as a collaborative endeavour. Stakeholders should avoid siloed implementation where possible, for example by creating shared core AI models for subsequent tailoring to different specifications and contexts. Enabling activities are transversal in nature so this chapter will explore further opportunities for driving collaboration around AI.

6.1. Activities 'enabling' the success of the roadmap

Enabling projects are activities that are required for starting the development of several use cases (e.g. ensuring the availability of suitable development infrastructure) or to ensure coordination and alignment across different initiatives (e.g. to share knowledge). Enablers can be identified by assessing the so-called 'AI readiness' of an organisation. To perform this assessment, it is useful to think across seven different categories (referred to as the 'AI readiness framework'): Strategy, People, Process, Ethics, Data and Technology. Each of the activity streams are discussed below, with key activities listed and translated into an indicative roadmap (see section 6.3):

6.1.1. Strategy

The programme of work defined in this study involves multiple processes and stakeholders. To achieve success, the vision and goals of the AI programme should be aligned to broader business objectives (at the strategic level, i.e. with leadership buy-in). Some of this is already achieved via the prioritisation analysis and strategic rationale articulation performed during this study (within the broader context of EU-level AI strategy). There should also be programme-level oversight over the enabling projects. Some of the key activities that are relevant here are:

- Define an AI vision and goals that align with existing strategies, business objectives and across leadership;
- Coordinate the enabling capabilities across the programme (e.g. a central "hub" CoE model, discussed in section 6.3);
- Define future innovation aspirations and processes for extending beyond the timeline of this study.

Depending on the set of opportunities and involved stakeholders, the strategy enabler can require different priorities:

- **At European Commission level**: The current study has been looking at nine main processes in the context of migration, security and border control from a multi-stakeholder view. The Commission itself (e.g. DG HOME) will have to implement some of the opportunities identified in the context of this study. This implies a clear ambition and defined approach to implement the initiatives within the Commission. For example, the opportunity around the use of AI to improve policy making by linking regulation requires alignment within the DG but also potentially with other DGs of the Commission where this use case could also provide value (as also possible support from DIGIT). As such, the Commission will be responsible for laying out the overall AI strategy and direction for this domain of Border Control, Migration and Security however the agencies or the member states authorities will need to further adapt and evolve the strategy to match their needs.

- **At Member State level:** AI maturity levels across member states can vary significantly, based on factors such as strategic direction on AI, legacy technology, data availability (from air, land or sea border crossing points) and available skills. The study has considered member states' point of view by including some member states in the methodology. However, clear AI strategy, as an evolution to the current study, is still required at national level to successfully implement the opportunities mentioned in this document. Member states have different challenges when it comes to migration, security and border control depending on their own local societal and political contexts and on the factors noted above. Responding to these challenges should be included in their specific AI strategy. As a simple example, the opportunity on predicting the flow of travellers (land, sea, air) to better allocate resources might not be as relevant for a member state that does not have an external land border. As a part of their strategy, member state agencies should also consider reusing solutions that other member states would have already deployed across the EU. From a responsibility perspective, national authorities will be responsible for taking inputs from this study, and creating their respective strategies

- **At Agency level**: From an agency point of view, agencies like eu-LISA will be key in driving the AI agenda forward. From a Strategy point of view – they will have two key responsibilities. Firstly, they are likely to play an "enabling" role for the member states in their implementation of AI. Secondly, they will have to focus on a strategy for their own AI implementations (e.g. AI based predictive monitoring of systems). This study has been looking at the specific case of eu-LISA, with some use cases identified. In that context, managing capabilities within eu-LISA is key in order to successfully implement those AI use cases.

6.1.2. People

The people and skillset requirements for this roadmap have been described in sections 5.1 and 5.3. As such the type of skillsets required to implement the programme of work will require a good mix of expertise on policy & legislation, privacy & ethical standards, process design & innovation, technology architecture, data science, AI platform development and engineering. Aside from these, there will also be specific skills required for the management and governance of this roadmap like training and change management to enable staff within the relevant authorities to get up to speed. A key part of this enabler will be the AI Centre of Excellence as described later (see 6.2).

As noted throughout this report (for example in sections 5.2 and 6.2), there are benefits to be expected from leveraging the overlaps between different AI opportunities and initiatives. To capture these, a central capability might work to ensure that implementation teams have the requisite specialist technical knowledge. Some of the key activities that are relevant here are:

- Provide oversight and general leadership to AI implementations.
- Coordinate talent resourcing, with size and mix of skills linked to current in-flight AI opportunities. Specialists might be data scientists (with knowledge of and capability in AI model development and statistics), AI-specialised software developers (who can work with chatbot development platforms, for example) or individuals with strong working knowledge of the business processes and how AI might affect them.
- Coordinate the capture and sharing of knowledge and learnings from AI developments. This knowledge sharing could be achieved in multiple ways, ranging from internal presentations to codebase sharing to sharing of specific talent resources across initiatives.
- Lead on change management by defining the approach most suitable for the given agencies, member states and other stakeholders, and delivering in tandem with AI implementation (for example by delivering trainings or educational material).

However, skill requirements and responsibilities will vary between the Commission, central agencies and the member states authorities.

- **At European Commission level**: On one hand, while the Commission has some use cases that are focusing on the institution itself, while many of the other opportunities of the roadmap will have to be implemented by the member states. On the other hand, the Commission has a coordination role in this roadmap that is not expected from member states or from the agencies. In the end, this difference in roles concerning the roadmap influences the type of skills and the expected change management. DG HOME is not heavily requiring so much of technical profiles but rather business-oriented skills to evangelise the use of AI across the EU. Aside from this, the Commission will need the right skill sets related to legislative implications, data privacy and ethical standards on the use of AI, to be able to set the direction and standards for adoption across the EU member states.

- **At Member State level:** The implementation of the majority of AI use cases will happen at the member states. This would require people & skills across various domains as follows:
  - Legal / legislation: National authorities will need skills pertaining to interpretation of legislation and ethical guidelines pertaining to the use of AI for Border Control, Migration & Security with the ability to transpose some of the requirements into their national legislations.
  - Process analysis & optimisation: Process modelling skills will be needed to change / optimise existing processes pertaining long / short term visa issuance, SIS II / SIRENE, asylum processes.
  - AI build / technology integration skill sets: National authorities will need the right AI technology skill sets to design and build AI algorithms for the various use cases and will need the capability to run PoC's, create MVPs and scale within their existing constraints.
  - Change management & PMO: The changes to be introduced by the implementation of the AI use cases will require proper change management and training skills at a national level. PMO and project management skills will also be critical as coordination between multiple national stakeholders may be needed for some of the use cases.

- **At Agency level**: Similarly to the member states, the impact of the AI programme should be bigger on the agencies from an organisation, talent and change perspective. For instance, leveraging chatbot technologies for supporting service desk impacts current service desk organisation but also requires the agency to master the chatbot technology for development and future maintenance. This will require skills on data science, AI implementation, management, maintenance and reporting. The key agency in consideration here is eu-LISA, however the situation pertains to all other agencies who are looking to implement AI use cases within the domains of Border Control, Migration & Security (e.g. EASO, Frontex). For any of these agencies looking to implement AI for their own

organisations, many or all of the skillsets described above for consideration by member states will also be applicable.

6.1.3. Processes

This study has been framed by the business processes in scope. Any change to these processes should be managed in a consistent manner, such as by designing appropriate metrics and controls (or providing guidance to do so). The AI use cases identified do not aim to fundamentally change the underlying process, however do look to test the applicability of AI to improve the overall efficiency. Some of the key activities that are relevant here are:

- Maintain oversight of operational KPIs (while the individual stakeholders using the AI solutions would maintain the day-to-day oversight of KPIs, a central capability may be well-placed to monitor performance at the programme-level).
- Ensure consistent approach to different processes.
- Ensure well-defined funding mechanisms.

The process dimension aims at establishing and redesigning well-defined processes and controls to enable successful AI implementation. Those processes and governance mechanisms will vary depending on the stakeholder involved.

- **At European Commission level**: The Commission will be responsible for setting out applicability of AI and the resultant implications across all the processes in scope of this study. Given there may be subtle differences in the way the processes are carried out in the individual member states, the Commission will set out at a broad level the AI implications, and the member state authorities or the agencies will have to work through the details and finer aspects of the AI implications on the underlying processes.

- **At Member State level:** member state authorities will have the ownership of looking at their individual processes to assess the implications of leveraging AI technologies. Member states will have an operational view on the implementation, which should result in a closer follow-up and monitoring of the implementation of specific use cases. They will potentially also have their own funding mechanism and could benefit from cross-member states initiatives (coming either from the Commission or from member states between themselves).

- **At Agency level**: Challenges for agencies are very similar to the ones at member state level. It is mainly about following-up on use case delivery and governing those. Funding mechanisms are to be defined, either from the agency itself or in collaboration with the Commission.

6.1.4. Ethics

This study has commented significantly upon the ethical implications of the AI initiatives. Managing ethical considerations from a central perspective is a good way to ensure consistent alignment with the ethical guidelines as set out by the EU HLEG on AI Ethics[41] (please refer to the report from the first phase of this study). Some of the key activities that are relevant here are:

- Establish mechanisms needed to understand how AI is being developed and applied, in order to enforce the use of AI in a trustworthy manner, and ensure values and integrity are embedded in AI-

[41] See the following link for a list of principles: https://ec.europa.eu/digital-single-market/en/news/ethics-guidelines-trustworthy-ai

driven initiatives (e.g. by setting out best practices and providing technical or process expert guidance).
- Create an ethics board for expertise and review – this is a potential way to ensure ethical risk is practically addressed across the programme.

The ethics dimension focuses on the mechanisms needed to understand and prevent AI bias and ensure values and integrity are embedded in AI-driven initiatives. This is obviously applicable to all stakeholders. The difference resides in the type of uses cases that stakeholders have in scope.

- **At European Commission level**: AI ethics need to be considered across the implementation of the identified AI use cases. From this perspective, the role of the Commission will be to set out the ethical standards and guidelines to be adopted by the various member state authorities and central agencies, while looking at the implementation of their respective AI strategies. There are some existing forums within the Commission like the AI Ethics for Law Enforcement that bring together various member state agencies, that can be leveraged for this purpose. For the use cases pertaining the Commission themselves (e.g. policy creation and transposition) the need for preventing biases is not a major challenge as there is no personal data involved in this use case.

- **At Member State level:** member states are exposed to the ethical risk of using AI, and so should take into consideration the guidelines that will be set out by the Commission in this regard. Member state authorities have the responsibility of complying with the ethical guidelines required for the implementation of the AI use cases. While complying with the guidelines, member state authorities are also welcome to put in additional measures at a national level to ensure the ethical use of AI.

- **At Agency level**: Agencies like eu-LISA and EASO are likely to have a role to play as "enablers" in helping member state authorities with the implementation of their AI solutions. The AI use cases pertaining to the agency themselves are mostly related to improving the efficiency of operations of central EU systems (e.g. OPS regarding eu-LISA) – and there is limited direct access to PII (personally identifiable information). From this perspective, the risk of non-ethical use of AI is lower. However, there could be exceptions. For example in the case of ASYLUM-4 (individual risk assessment), agencies such as EASO might be involved on a central level to support member states in their implementation. Here the agency has a clear role to help ensure ethical principles (and other political and social sensitivities) are considered given the sensitive topic of the use case. It is therefore important to understand case-by-case the type of use case (e.g. pure operational or regarding individuals) and the involvement of the agency.

6.1.5. Data

The first phase of implementing each AI opportunity will involve data gathering and analysis. There are commonalities across opportunities and initiatives with regards to the types of data needed for different AI models. Similarly, different AI solutions will require integration into the same systems when moving into production. Central support would minimise the effort required in these tasks. Some of the key activities that are relevant here are:

- Lead on data extraction protocols even if not specific responsibility.
- Provide oversight on data privacy and protection protocols.
- Facilitate data sharing across opportunities where relevant (e.g. share specific data extracts, or integration procedures/APIs).

A well-defined system for data governance, engineering, security, and operations (including sourcing, access, and quality management) should be set-up in the data dimension.

- **At European Commission level**: In most of the opportunities, the Commission does not own the data. This means that the Commission will not have a direct role to play when it comes to ensuring data quality, extraction or security and privacy. Nevertheless, the Commission should provide guidance in order to have the appropriate data standards and guidelines in place. DG HOME could also help in ensuring consistency of the data in use for the border, migration and security domains as well as setting up clear data strategy. The Commission should also make recommendations on the implementation of AI use cases that leverage common sets of data – such that the implementation of these use cases can happen in parallel.

- **At Member State level:** The member state authorities will have the responsibility to identify the various data sources required for the implementation of the AI use cases identified in this study. They will have to establish ways to capture, extract, transform and use the data in a proper manner to be ingested by the AI algorithms. Without this, the accuracy and insight coming out of the AI models may be inaccurate. For example, assessing the risk of a TCN for a specific application will require data from various sources like the central VIS / SIS II, national law enforcement databases, airline manifest data to name a few.

- **At Agency level**: Specifically for eu-LISA, the agency will have the role of the owner of the systems (e.g. VIS) that host the data required by member state agencies in order to implement the identified AI use cases. From this point of view, agencies like eu-LISA will have to ensure easier and timely access the required data sets. Apart from this, for the implementation of AI for the agencies themselves, the right level of operational data needs to be available to be leveraged by the AI algorithms. For e.g. in the case of the use case on predictive monitoring of systems, the AI algorithm will need access to incident / problem logs and resolution mechanisms over a defined period of time.

6.1.6. Technology

This study covers a broad range of potential stakeholders (e.g. member state authorities) who would be involved with developing or using AI solutions. To avoid fragmentation (which could in future lead to separation of or discrepancies between, solution deployments), as much effort as possible should be expended upfront to create alignment. Some of the key activities here relevant are:

- Provide common view of development environments used across different opportunities (e.g. capture learnings and suggest best practices). A simple example would be ensuring alignment of the programming languages (and/or packages) used, especially where this is aspiration to link solutions together, or borrow functionalities during development.
- Coordinate a common technology platform for usage along the full AI cycle, which would support the broader interoperability agenda of the Justice and Home Affairs (JHA) ecosystem by creating common technology and mindset change. We are "entering an 'interoperability era', which will bring down the artificial silos of large-scale IT systems and change the way law enforcement officers, border guards and migration officers work and cooperate" and as such a "well-defined information architecture is an opportunity to take the work of our internal security community to a qualitatively new level."[42]
- Liaise with third party vendors where necessary. Any future procurement discussions should be managed centrally to avoid fragmentation with regards to technology and financing.

[42] See https://www.eulisa.europa.eu/Publications/Corporate/WK%2012456%202019%20INIT.pdf

- Invest in research and innovation where applicable (e.g. when state-of-the-art technology is not sufficient for the desired capabilities).
- Coordinate on deployment options and environments (e.g. maintain oversight of a shared Cloud development environment).

The challenges are then about setting up the appropriate AI technology platforms to operationalise AI assets, including vendor strategy, interoperability and computing environment.

- **At European Commission level**: The above discussed technology dimension implies that the Commission should set-up and leverage its existing technology platform to implement their own use cases. They can also have a leading role in establishing and transmitting best practices to member states and agencies; the Commission should also be responsible for driving the re-use of technologies across the member states (where feasible and appropriate) to expedite the implementation of the AI use cases. As mentioned above, this 'interoperability' of AI approaches can be coordinated through a common technology platform. This coordination would require political commitment in addition to technical capability and hence the best results would be achieved with collaboration between ecosystem stakeholders and the Commission. Through the AI CoE (described in the next section), the Commission can enable testing and standardisation of various technology requirements for the AI use cases. Furthermore, in this context the Commission will have the role of a "standards authority" for the deployment of AI solutions across the member states and agencies within the domains of Border Control, Migration & Security. The Commission can also invest in research and innovation to contribute to developing AI technologies beyond the state-of-the-art.

- **At Member State level:** member state authorities have multiple choices when it comes to the technology dimension. They can set up their own AI infrastructure to implement and evolve the use cases identified in this study. Technology options for the AI platform will have to be made by the member state authorities, however they can leverage the assistance of the AI CoE that has been conceptualised. Obviously, there is also a huge potential for reuse or sharing infrastructure between the member states, which would mean setting up and reusing technology components within the EU. For example, a chatbot developed to assist in the visa process would contain elements to be reused where possible across member states. This reuse is not limited to purely technological assets like code, but may include other technical components developed during a project (such as data analysis frameworks, performance benchmarks and testing requirements). Member state authorities will also have to look into their own organisations to assess technology skill set requirements, as described earlier in this section.

- **At Agency level**: For central agencies like eu-LISA, specific technology choices need to be made in line with the future direction of the agency. These technology choices will need to align with and be compatible with the existing and future core business systems run by the agency (where applicable). Given their technology maturity, agencies like eu-LISA could also take on the role of advising the member state authorities on effective implementation of some of the identified solutions or provision of infrastructure. This may involve contracting with external providers to license platforms (for chatbot development, for example) and setting up infrastructure within the agency to make it available to member states, or supporting member states with advice on a recommended approach and standardised set of platforms and infrastructure. All of these activities may fall within the scope of a common technology platform which, as already mentioned in this section, will support broader interoperability. While cooperation between JHA stakeholders is crucial to this endeavour, eu-LISA (as the JHA agency leading on interoperability) would be expected to take a leading role.

6.2. AI Centre of Excellence (CoE)

A common practice for complex technology implementations taking place across multiple stakeholder is to establish a Centre of Excellence (CoE) or "Technology Hub". This section further expands on the CoE model as a potential way of delivering the enabling capabilities as described in the previous section.

Centres of Excellence are flexible communities of specialists built to address common goals around a topic or technology. By bringing together business and technology stakeholders, CoE's can develop best practices, build use-case solutions, and provide training, and share resources and knowledge to, in this case, increase the chance of a successful implementation programme.

The CoE is thus a central governance model that could be used (e.g. by DG HOME, within the context of this report) to coordinate and enable the implementation of AI opportunities across the Commission, member states and other central agencies. The Hub would need a broad set of capabilities (e.g. strategy, operating model & services, technology) with size and mix linked to ongoing AI initiatives. Such a CoE would benefit from being managed and run centrally with involvement from relevant stakeholders who will drive the implementation of the various use cases (e.g. Member states) as depicted in the figure below:

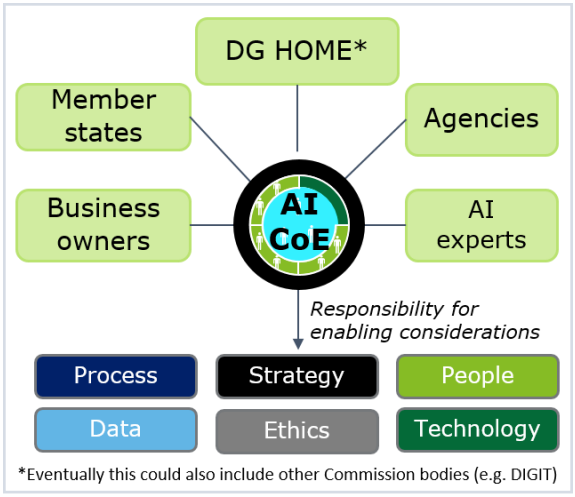

Figure 17: Schematic representation of the potential AI CoE structure and responsibilities

Concretely, this CoE would have the following key elements:

1. Facilitate the integration with the border control, security and migration processes and systems: The CoE would act as a "test bed" for member states and other agencies to trial new processes and technologies driven by AI solutions. To this effect, and specifically from the perspective of border control, migration & security, the CoE would potentially host test instances or virtualised simulations of key central systems like VIS, SIS II, ETIAS and EES. This would ease the adoption of the AI opportunities within member states and agencies as well as development, testing and the integration work (both for rapid development of PoC's and MVPs). To avoid duplication of effort, new test instances should only be hosted where there is not an existing mechanism for straightforward access to data and systems for AI testing (parties contributing to the CoE should make their knowledge and infrastructure available to the benefit of driving the overall roadmap). A test instance or simulation would be designed to provide an environment for AI development insulated from production systems.

2. Design and set-up an AI platform. The CoE would have in place an AI platform or tools to support member state authorities and other agencies to rapidly create AI prototypes and test them within the CoE, ahead of looking to create an MVP or scale the solution in production. The exact form of such a platform is to be defined and could range from pure technology tooling advice and knowledge, virtualised and Cloud-based data processing, management or analytics services, or a physical space with AI experts. As mentioned in section 6.1.6, a shared platform is an opportunity to drive the broader interoperability agenda and accompanying mindset change.
3. Provide services and capabilities to the agencies and member states: The CoE would provide a set of services around AI research, specific projects / PoC development, innovation, guidance and monitoring on some of the enabling dimensions mentioned in the previous section such as funding mechanisms, regulatory impacts of AI, ethical guidelines. These services will be defined in collaboration with the member state authorities and other agencies and the right operating model to help invoking these services will need to be defined. This will help in driving towards an increased AI maturity in the EU.
4. Standards authority: The CoE may over time evolve and become "standards & certification authority" for AI leading practices, policies and guidelines pertaining to implementations within the domains of Border Control, Migration & Security (could be extended to other domains as well). This would also mean that the CoE could certify the use of certain technologies for the implementation of AI across the EU, that would lead to standardisation and would lower overall costs of deployment.
5. Ensure adequate governance of the CoE: the stakeholders responsible for governing the CoE would be a combination of EU agencies, member states representatives such as AI technology providers and small and medium enterprises (SMEs). This roadmap has not been produced assuming a formal requirement for industry partners. Nonetheless, Commission has recognised as part of its AI strategy[43] that involvement from the private sector in research and innovation is crucial for building "an ecosystem of excellence that can support the development and uptake of AI across the EU economy and public administration". Europe is well-placed with its "excellent research centres, innovative start-ups, a world-leading position in robotics, competitive manufacturing and services sectors, from automotive to healthcare, energy, financial services and agriculture, [and] has developed a strong computing infrastructure (e.g. high-performance computers)". As such, there is a wealth of capability which could potentially be utilised for talent and expertise. The selection of industry partners can be based on various parameters such as technological maturity, breadth of offering, alignment to specific initiatives and/or commercial arrangement. Furthermore, it should be recognised that new and niche AI players are expected to emerge as AI technology and research advances over the same timeframe as the roadmap.

   The involved stakeholders would drive the agenda and steer the direction of the CoE, in alignment with the AI roadmap and broader European Commission context.

It is important to realise that not all capabilities would be required immediately: the size and blend of skills should be linked to the in-flight AI implementation projects and so the CoE would be run with a flexible resourcing model.

Recently (February 2020), the European Commission published a White Paper outlining its vision for AI within the European Union[44]. In this paper, a number of recommendations and guidelines were given for governing the work of AI within the Union. A governance model similar to the CoE was presented as one such recommendation. Other recommendations included a call for re-use and synergies between Agencies and member states by means of an active network. Furthermore, in 2020 the Commission launched a specific

[43] Source: https://ec.europa.eu/info/sites/info/files/commission-white-paper-artificial-intelligence-feb2020_en.pdf
[44] See COM(2020) 65 section H for the full document (same as previous source)

call[45] (Protecting freedom and security of Europe and its citizens) for research on artificial intelligence and security within its Secure Societies programme.

Obviously, setting up such a CoE is one of the immediate next steps of the AI roadmap. This study is suggesting potential set-up and recommendations but the set-up of this body is an initiative in itself. One of the first actions required is to develop the strategy, operating model and the investment case for the AI CoE.

Finally, it should be mentioned that there exists already a number of AI innovation Hubs (or CoE) within the EU landscape. Different types exist, on the one hand specific Hubs for member states and EU companies which like to leverage AI, as also specific hubs within the Commission for its own purpose. Examples include, "One Data Incubator Europe (ODINE)", "Robotics Digital Innovation Network (RODINE)" and the "European Institution of Innovation and Technology (EIT Digital)"[46]. The latter, EIT, provides accelerator services to businesses within Europe. Internally at the Commission, DIGIT (D1) has services to provide DGs with support in developing AI solutions. Given the number of existing initiatives related to the setup of broader innovation hubs, there may be a need to align and reuse capabilities, and a benefit from collaboration.

6.3. Sequencing of the enabling activities

As discussed in the previous section, the CoE is a suggested model for DG HOME (and/or relevant EU institutions), which would play a key task in coordinating the different responsibilities in the outlined roadmap. The next figure provides a suggested timeline of the different tasks involved.

This begins with a series of projects about defining the practical approach for addressing each of the enabling considerations explored in this section (for example setting up a central oversight body for ethics and risk reviews). These enabling elements should be in place before attempting to develop and implement large sets of AI opportunities. The CoE model is then expected to provide a flexible resourcing model for delivering these enabling capabilities to the implementation projects, and may ramp up depending on which specific opportunities are being addressed at a given point in the roadmap timeline. Examples of this are shown in the graphic below, for example coordinating scaling efforts across the various chatbot opportunities and supporting the gathering and sharing of appropriate datasets across similar knowledge management and natural language processing use cases in 2021. These are shown on the figure as 'indicative focus projects', where there is a strong potential opportunity for enabling services provided by the CoE to support the main roadmap (for example, a general 'ethics review' could look at a family of AI opportunities that are implemented around the same time).

There is a separate project to be taken at the central level which is placed into the Strategy stream for 2022, namely enabling future innovation processes for ongoing AI work beyond the scope of this study. The rationale for placing this activity at this point in time is to have it completed before an influx of transversal opportunities scheduled for 2023, whereby central capacity may become constrained.

[45] See https://ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/main/h2020-wp1820-security_en.pdf
[46] See https://ec.europa.eu/digital-single-market/en/digital-innovation-hubs

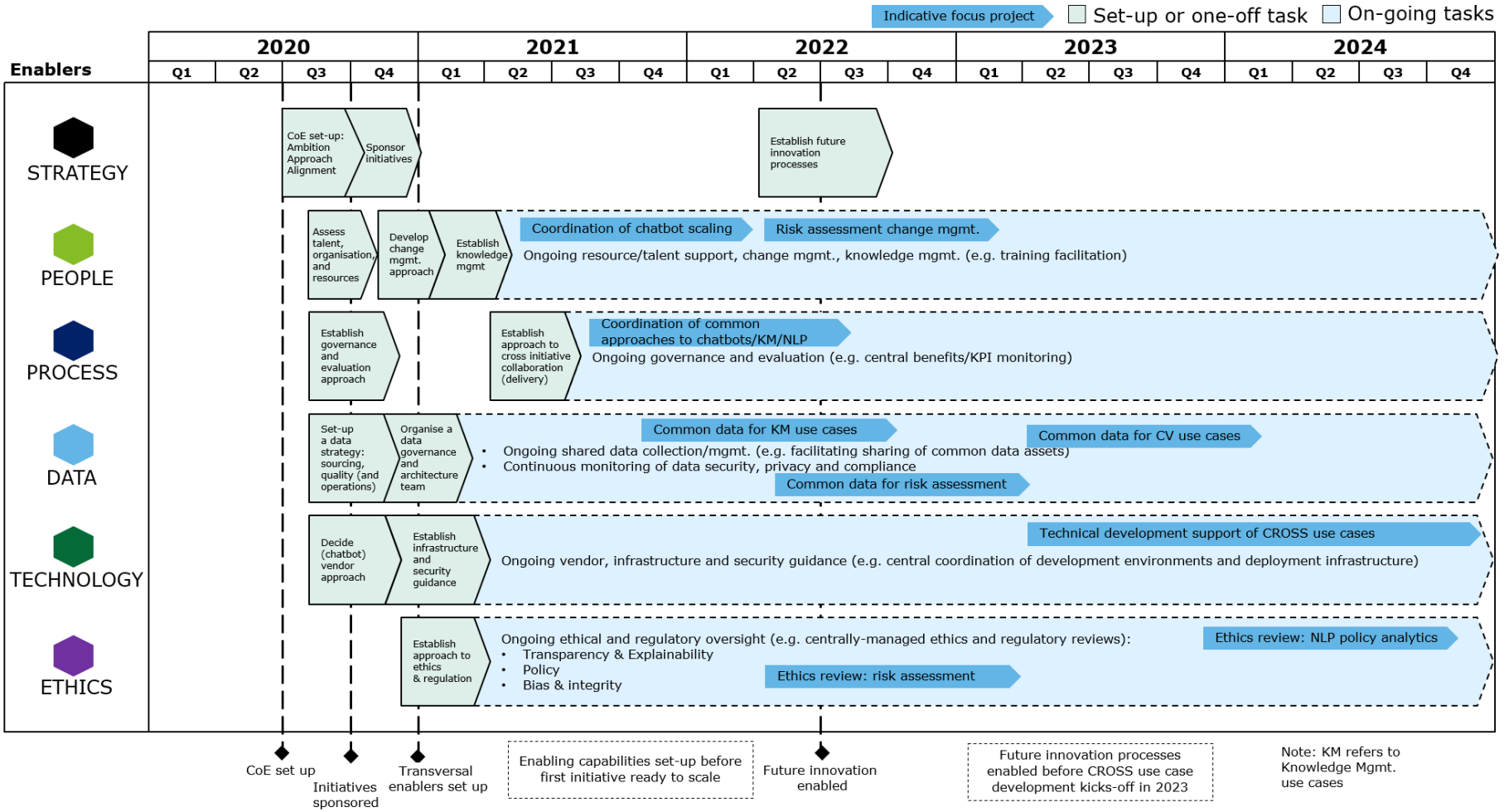

Figure 18: Detailed view of the different steps in the enabling initiative

7 Final recommendations and conclusions

This chapter provides a reflection on the work done in this study and suggestions as to how DG HOME and related stakeholders can progress in their AI journey. AI is a technology like any other; whilst many of the recommendations are akin to those given for other technologies, the unique challenges that AI poses and the rapid evolution of its ecosystem make it key to stay agile and make adjustments when and where needed. The opportunities identified, the roadmap formulated, and the key enablers outlined, all currently stand to help DG HOME and related stakeholders in furthering the use AI to drive efficiency and better citizen outcomes. However as future demands change, and technological options evolve, what will be most important in the long-term is the capability to knowledgably and independently adapt the course of action to suit these evolving needs.

Whilst identifying use cases at the outset of this study (through numerous interviews, workshops, and follow-up discussions), an approach that balanced current needs with future aspirations was followed. The resulting long-list consisted of ideas that spanned:

- AI for automation and streamlining of processes
- AI for better citizen and employee engagement
- AI for deeper insights from the increasing quantities of available data

The prioritisation exercise that followed aimed to assess each concept for its potential value and overall feasibility, and the resulting short-list of prioritised use cases formed a portfolio that balanced types of AI, value drivers and overall technical complexity. Many of the deprioritised use-cases are still worthwhile in their own right, and it would be recommended to keep these in mind if re-evaluating the roadmap in future circumstances. During this prioritisation exercise there were two particular factors of note that stand out as important areas for future considerations: the ethical nature of a use case, and the availability of data for use cases.

Regarding ethics, the Commission's guidelines for trustworthy AI provided a helpful and robust framing for the principles that AI solutions should follow in order to be deemed ethically feasible. Ethical value is a closely related dimension to this, characterising the ability of an AI use case to improve ethical outcomes, as well as demonstrate the ability to develop AI tools in a principled way. For use cases with a strong ethical component, it is important for DG HOME (and associated stakeholders responsible for implementation) to capitalise on the opportunity to demonstrate that sensitive use cases can be achieved in an ethical, trustworthy and transparent manner, seeking to assuage potential public concern throughout the development of these solutions.

Additionally, as progress is made against this roadmap, it is worth putting increasing focus on the mechanism by which new use-cases and solutions are monitored for their alignment to these ethical principles – particularly for those concepts where there are a number of entities involved in the development (for example, solutions that are developed and deployed independently within member states).

Regarding the availability of data; as demonstrated by the ideas short-listed in this study, there is much value to be captured through more effective use of the data that already exists within systems. A recommendation for the future would be to understand how current data capture across Border Control,

Migration, and Security could adapt in order to enable some of the use cases that are currently deemed infeasible due to constraints on this front.

Individual prioritised use cases were collated into initiatives presented in a five-year roadmap highlighting the different dependencies and benefits realised by each, with various considerations and enabling activities also discussed. The roadmap will see significant internal efficiencies and external experience improvements brought in to the processes at the start, followed by augmentations to human decision-making (with knowledge, risk and policy analytics solutions). The roadmap concludes with a set of more advanced and ambitious AI use cases which would show DG HOME and related agencies as highly mature with regards to these new technologies. The overall sequencing of the initiatives aims to help achieve short term value, and in parallel, aims to build capabilities and learnings that better facilitate future endeavours. As with any technology, it important that key stakeholders will need to be convinced of the potential value of AI opportunities (prior to full-scale developments) in order to unlock the required funding, organisational support, and focus in the midst of numerous priorities. Therefore, this roadmap has followed the recommended approach of starting with a simpler PoC and iteratively increasing the solution complexity and scope.

As noted in the study and above, it will be important to prepare the programme across different 'enabling' aspects such as Strategy, Data, Technology, People and Process to ensure success. However, efforts should not stop once a subset of the enabling elements are made available. A common pitfall of AI implementations is an overly narrow focus (usually on technology development) with not enough attention spent on successfully developing the wrapper of management systems needed to validate initiatives (including cost/benefit analyses), evangelise the project to stakeholders and employees, scale projects from pilot to implementation, and track ongoing performance.

The governance mechanisms discussed in this report, such as the CoE, are seen as key to addressing these surrounding points, to maximise the benefits of each initiative. In addition to helping achieve the benefits expected, these constructs also offer the chance to more equitably develop capability across member states (where there the ability to ramp up AI capability may vary across states), through knowledge sharing and potential re-use of methodologies, techniques and tools. These collaborative aspects can also help to instil a culture of collaboration around AI, to avoid fragmentation and potential duplication of effort (if subsequent AI studies are undertaken by DG HOME, for example).

In closing, the reader should understand that this roadmap should be used as guide to assist with implementing the AI initiatives as defined in this document. In other words, the roadmap is a strategic plan that defines a goal and includes the major steps or milestones needed to reach it. It also serves as a communication tool and a high-level document which articulates strategic logic (the 'why') behind both the goal and the plan. Different external factors might change in the coming months; therefore, the roadmap must be seen as a toolkit with different elements that can help the organisation in their implementation journey, with the acknowledgement that depicted elements (synergies, dependencies, constraints, etc.) may shift. Considerations for adapting the roadmap in the future might include new technological advances (with AI platforms and academic research becoming ever more mature), new migration trends and projects within the EU, specific member states considerations and needs, and so forth.

Finally, this study benefited from many enthusiastic stakeholders in the European Commission ecosystem, willing to explore using AI to improve their day-to-day work. The stakeholders understand that AI has a high potential but should be tackled in a considerate manner, as reflected by the general suggested approach to development. Furthermore, there will be regulatory, political and technological challenges necessary to be overcome. Despite these, DG HOME is excited to harness AI for the benefit of borders, migration and security in Europe.

Annex A | Overall roadmap and technical grouping of the opportunities

As described on page 2 and 3 of the Executive Summary, a larger figure of the roadmap with the technical grouping overlay is shown here. It shows the different categories of focus throughout the programme of work.

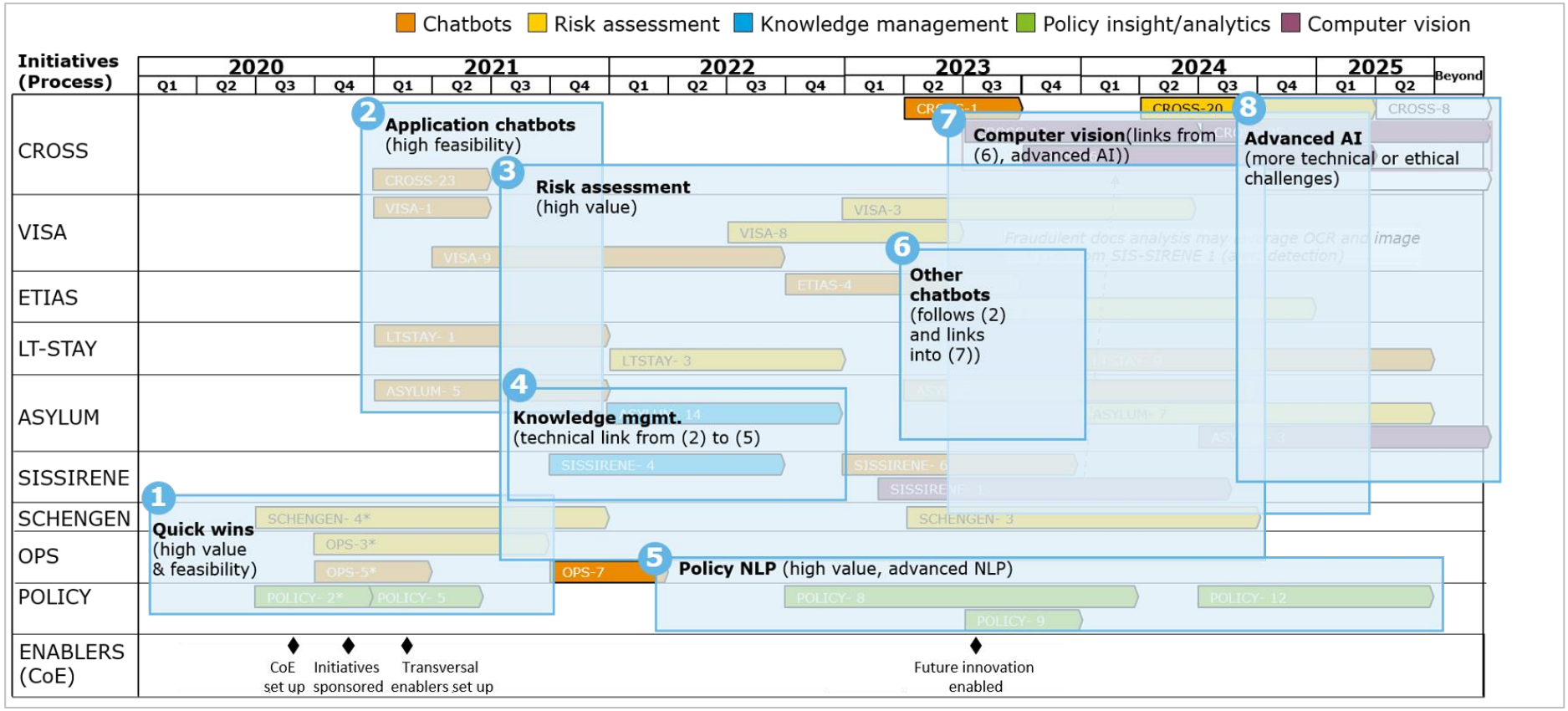

Figure 19: Roadmap with technical grouping

The following figure provides the full roadmap without the technical grouping as explained in section 2.2.2.

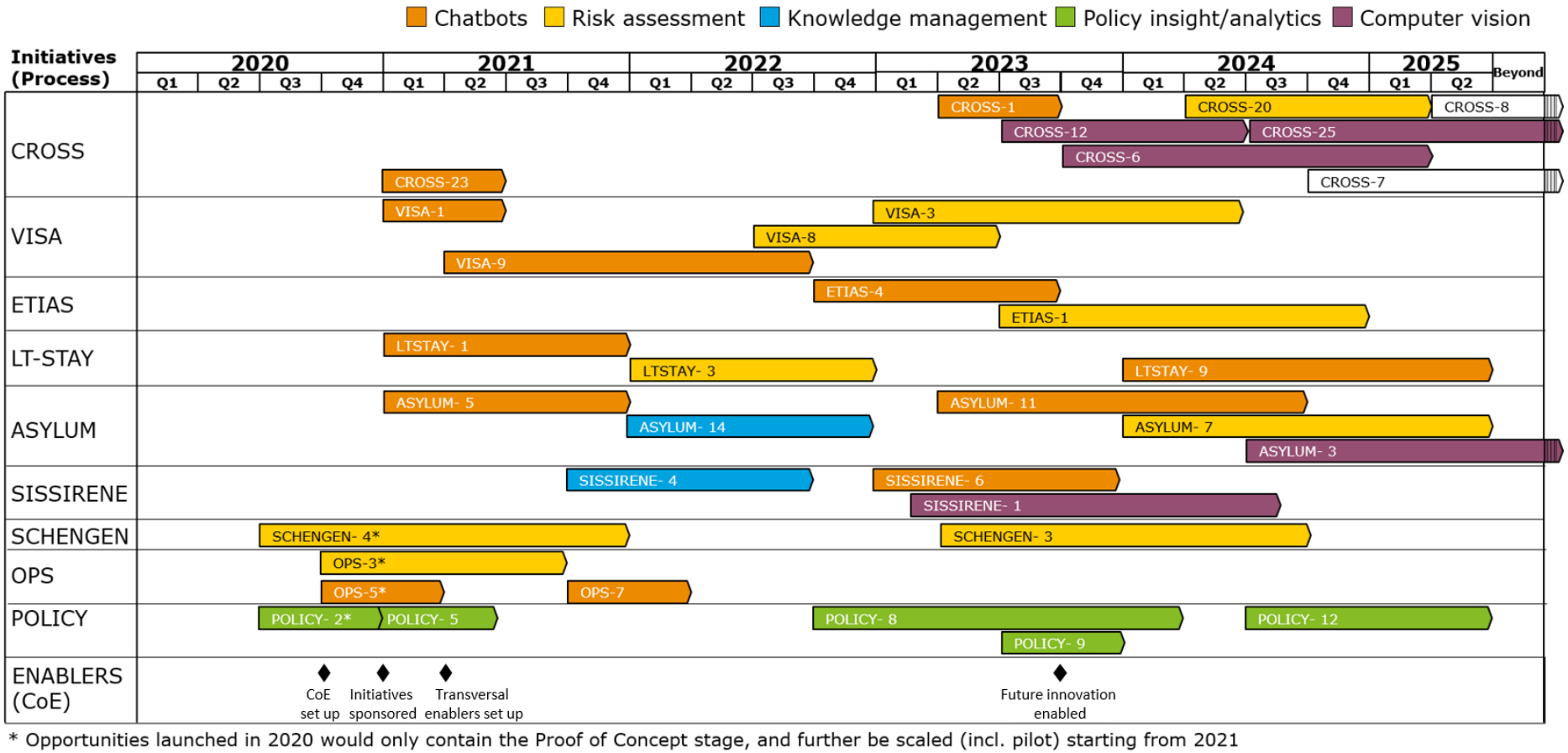

Figure 20: Overview of the proposed roadmap (large)

Annex B | Descriptions of the prioritised use cases per initiative

The list of use cases identified in this study is given below. Note that the IDs are not always consecutive as the list already reflects preliminary rounds of prioritisation.

ID	Problem statement	Use case description
Initiative 1	**Visa issuance for short stay**	
VISA-1 Application chatbot	Visa applications can often be confusing for applicants as information on the requirements can be hard to find. This is because the application process is not always equal across the member states. Moreover, requirements can be different depending on the TCN country of origin. Furthermore applicants are not always aware which type (e.g. short or long stay visa or ETIAS) they require for their travel. These factors can potentially cause people not to complete their application correctly (or partially). This means that visas are potentially (unfairly) not granted (which is ethically undesirable). Furthermore, incomplete or inaccurate applications can lead to visa case handlers spending time to non-value added tasks.	**The use of an AI chatbot for individuals requesting a visa that supports applicants during the online application process.** This can be either to (1) take in information and automatically fill in the form, or (2) as a support bot to answer questions (e.g. "in what languages should I provide a document?"), or (3) ensure quality of provided information through data validation. This chatbot could be possibly further enhanced by a multilingual chatbot answering questions in the TCN's native language. Automatically filling in the form can be accomplished through integration with databases (and then some kind of identity authorisation), or by NLP techniques like predictive modelling. There could also be 'spellcheck'-like features (e.g. fuzzy string processing) to improve data quality at source. Chatbot frameworks commonly provide conversational components including direct questions and scripted information exchanges, as well as machine learning-driven features to suggest likely answers to common questions (usually based on supervised training from example conversations. It is possible that this could be generated through usage of the chatbot in a training context). Data validation can be treated as a separate module (although in practice would likely be incorporated within the chatbot for real-time checking) and performed on different levels of complexity. A simple implementation could be using regular expressions ("regex") to e.g. check if a birth date is in the right format (e.g. DD/MM/YYYY). A more advanced technique could be using deep learning for computer vision to assess veracity of a document (e.g. birth certificate), and would be more complex depending on which types of documents are validated and the level of detail required. The multilingual aspect would most likely require manual translation, although the field of neural machine translation (using neural networks for the task) is advancing with

ID	Problem statement	Use case description
		techniques like attention and transformer models
VISA-3 Application triaging	World citizens are now travelling more than ever. According to the United Nations World Tourism Organisation (UNWTO) international tourist arrivals grew 6% in 2018, totalling a staggering 1.4 billion people. Europe alone registered around 710 million international tourist arrivals, about half of this total number. Moreover, it is expected that this number will only increase in the next years. This will create a heavy workload for visa case handlers (as also border guards) assessing if an individual shall receive a visa or not. Moreover, it is also important to highlight that both the volume and the variety of applications will increase the case worker's required expertise.	**This use case is around using AI to classify visa applicants based on an initial assessment.** Classification approaches of this kind are similar to the concept of triaging in healthcare where an AI could process inputs like scan images and doctors' medical notes in order to allocate patients to their most appropriate next step. Here, classification categories could be defined based on a risk threshold or specific indicators, or less pre-defined where applications are grouped based on some 'learned' similarity (for example based on similar occupation or combinations of factors). The types of AI models would likely be supervised and unsupervised respectively for these types of outcome. Both approaches could use vector space models, where the concept of an 'embedding' (which is a numerical representation for how an AI 'sees' data) is used to partition data into clusters (e.g. by a Support Vector Machine Classifier). Other Machine Learning approaches could include decision trees or random forests. Training a model as a classifier is probably the most sensible approach as training a regression model to predict some kind of score (for then separating by thresholds) instead might be seen as attempting to directly predict an exact risk level. The benefit of using AI is that it can be more robust or flexible, for example uncovering correlations between input data and classification outcomes or allowing for more variety in input (e.g. input text like given occupations could themselves be embedded using a pre-trained NLP model to capture intuitive similarity). As part of the risk assessment, the system could trigger automatic searches within national and central databases (SIS, VIS, etc.) checking if there are any hits that contribute to a higher/lower risk level. The relevant response could occur in different ways specific to both the system queried and the type of AI risk assessment model used. It could also work in combination with rules-based logic for codified actions in more serious situations. For example, a potential match with the SIS would most likely trigger a recommendation for an officer to further investigate the matched record, due to likely high risk, perhaps using rules-based automation. On the other hand, a match with the VIS not necessarily mean that this person is a risk. A match against a past or current valid visa does

ID	Problem statement	Use case description
		not show any sign of potential risk. However in a middle ground, for example if a match would detect that a person has one or more revoked visas, this information could be fed into an AI model as a predictive feature. Finally, as the AI searching algorithm would check different pieces of information, it could be developed to learn over time to perform more efficient searching (e.g. with reinforcement learning). The outcome of the classification could trigger different responses, like flagging for review by an officer with relevant experience or experience level. After this automatic assessment, a case worker will be notified which records should be analysed deeper and if there are any patterns which indicate a possible risk.
VISA-8 Identification of irregular travelling patterns	To avoid suspicion, some travellers take convoluted routes to avoid attention from authorities (e.g. going from Egypt to Belgium through Japan). Due to the complexity, these routes are not always identifiable by the authorities. This can lead to TCNs entering the Schengen Zone without having undergone appropriate assessment regarding risks such as overstaying.	**AI based approach to monitor, search and combine data from different sources such as VIS and EES (but also PNR data collected by airlines) to detect possible "irregular travelling patterns.** The AI could detect irregularity either at the 'node' level of a sequence of stops ("is it uncommon to travel from point A to point B?") or at the aggregate travel pattern level ("does the overall length and shape of this travel pattern appear to be different to usual behaviour?"). On top of that, the AI will be able to identify patterns which were not observed (as "strange") before. This kind of analysis is similar to fraud detection by analysing spending behaviour, or cybersecurity by analysing network traffic patterns, both of which are prevalent AI use cases, particularly in the Financial Services industry. Both supervised and unsupervised approaches could be considered, respectively: triggering automatic risk scoring based on observation or prediction (e.g. by partial completion) of patterns pre-defined as warning signals; or unsupervised uncovering of correlations between travel destinations. Other predictive features could be the length of overall travel in terms of number of stops or duration, or neural features like node embeddings. Approaching as a classification could use similar techniques as VISA-3 (application triaging). The outputs of this analysis could either prompt a human to investigate further, or feed into an "Engagement" based AI solution to ask the applicant for further information/documentation.

ID	Problem statement	Use case description
VISA-9 Tailored application form	Currently visa application forms are standard to every applicant. However, this can be sub-optimal, since not every person has to fulfil the same requirements and could have different risk levels. The result of this standardised application form is a delay in the overall process, since the "risky" applicant will be required to provide further information during an interview with a visa case handler. This means that this results into additional work for a visa case handler which could potentially be automated.	**Use of a personalised application form using AI to tailor questions asked to the applicant creating an augmented application form.** Tailoring could be performed pre-emptively if the identity of the applicant is already known in some way. In this case, data (e.g. from previous applications) could be located and pre-populated. Similar NLP techniques (e.g. 'spellcheck') as in VISA-1 (application chatbot) could be used. NLP could also be used for real-time personalisation by using information provided by the applicant as input data. Based on this, models could power the suggestion of questions (e.g. if a follow-up is likely based on historic factors). A concrete example would be a traveller from a specific region for which the system knows that there is a high chance of overstaying. In this case the applicant could be asked more questions on why they are travelling to the Schengen Zone and possible documents to support this. A human visa case handler will then be able to further verify this. Depending on the complexity of the form, more advanced AI techniques could be used. Reinforcement learning would be applicable for a modular form with plenty of variety, but would be more technically challenging. Another approach could be applying AI for the real-time processing and understanding of unstructured input data (for example extracting information from images using optical character recognition or object detection, or extracting named entities from free text inputs).
Initiative 2	**Issuing ETIAS travel authorisation**	
ETIAS-1 Risk assessment	World citizens are now travelling more than ever. According to the United Nations World Tourism Organisation (UNWTO) international tourist arrivals grew 6% in 2018, totalling a staggering 1.4 billion people. Europe alone registered 713 million international tourist arrivals, about half of this total number. By 2020, the European Commission expects that 39 million visitors (TCN) will enter the EU not requiring a visa (but nonetheless an ETIAS travel authorisation in the future). Moreover, it is expected that this number will only increase in the next years. This will create a heavy workload for case workers for travel authorisations and border guards.	**Enhance the accuracy and speed of the assessment by predicting the risk level of an individual once a match is found during the first automated query.** The model would perform a risk assessment of ETIAS applications by creating and flagging criteria for which an individual can appear "risky", e.g. based on the individual's data, based on criteria relevant to an ongoing scenario or threat (e.g. SMEs expect an increased number of Venezuelan citizens migrating to Europe illegally due to instabilities in the country), or developed from reviewing profiles (e.g. historical data indicates that single males around the age of 27 without any property in their home country are more likely to overstay). Moreover, as ETIAS will scan against certain risk indicators (see art. 33(4) of the ETIAS regulation), AI could support in selecting these indicators and possibly adapting them over time/depending on the applicant.

ID	Problem statement	Use case description
		Finally the AI model could scan different databases linked to the applications (e.g. which found a "hit") and present all the relevant extracts to the ETIAS officer. Note that one should keep in mind some elements of this proposal are not specified by the current regulation. Based on this risk level, applications can be classified for individual review ("triaging") by an appropriate case worker. Additionally, a suggested decision (e.g. similar cases resulted in the following outcome) could be provided by the AI model based on historical data (and thus similar applications). This would not only ensure a fair assessment, but also improve consistency across member states. Additionally, depending on the classification by the triaging step, a review could be done by an expert officer with experience of handling certain types of applications (e.g. from specific countries or based on specific risks identified) or applications which are relatively simple and can be handled by a less experienced case worker. This would ensure better resource planning. The technical approach and types of outcome would be similar to VISA-3 (application triaging) in nature.

ID	Problem statement	Use case description
ETIAS-4 Application chatbot	Travel authorisation applications can often feel confusing or overwhelming to people not familiar to the process or do not have the right skills (e.g. use of a computer, reading, and language). More specifically, filling in the questions posed to an applicant is not always straightforward for everyone. Furthermore applicants are not always aware which type of authorisation (e.g. visa or ETIAS) they require for their travel. These factors can potentially cause people not to complete their application correctly (or partially). This means that travel authorisations are potentially unfairly not granted (which is ethically undesirable). Furthermore, incomplete or inaccurate applications can lead to travel authorisation case worker spending time to non-value added tasks (i.e. wasting time on inaccurate or incomplete applications). For example, when an individual fills in a non-existing address or a typo.	**The use of an AI chatbot (or virtual assistant) for individuals requesting an ETIAS travel authorisation supports applicants during the online application process**. This can be either to (1) take in information and automatically fill in the form (e.g. by asking questions in dialogue like manner), or (2) as a support bot to answer questions (e.g. which permissions does the ETIAS authorisation provide me and which not?) or (3) ensure quality of provided information through data validation. This chatbot could be possibly further enhanced by a multilingual chatbot answering questions in TCN native languages. Data validation can be done on different levels of complexity. A very simple implementation would be assessing if a birth date is in the right format (e.g. DD/MM/YYYY). Alternatively, using computer vision to analyse image data (see 3.2.2) to assess veracity of a document (e.g. birth certificate), which would be more complex depending on which types of documents are validated. Please note that in most cases an applicant would not provide any documents as it is only in the case of a hit when this occurs. Thus one should understand that this solution would only be applicable in a minority of the cases. The technical approach would be similar to VISA-1 (application chatbot).
Initiative 3	**Issuance of docs for long-stay or residence**	
LTSTAY-1 Application chatbot	Applications for long-term stay or residence can often feel confusing for applicants as information on the requirements can be hard to find, processes are different across member state and requirements can differ depending on the country of origin of the TCN. Furthermore applicants are not always aware of which type of permit (e.g. single permit or blue card) they require. These factors can potentially cause people not to complete their application correctly (or partially). This means that the permits are potentially unfairly not granted (which is ethically undesirable). Furthermore, incomplete or inaccurate applications can lead to permits case worker spending valuable time to non-value added tasks.	**The use of an AI chatbot (or virtual assistant) for individuals requesting a permit and which supports applicants during online form completion process.** This can be either to (1) take in information and automatically fill in the form, or (2) as a support bot to answer questions (e.g. in what languages should I provide a document), or (3) ensure quality of provided information through data validation. This chatbot could be further enhanced by a multilingual chatbot answering questions in TCN native language. The technical approach would be similar to VISA-1 (application chatbot) and ETIAS-4, also see Destin.AI in Annex H for a similar example).

ID	Problem statement	Use case description
		Note: initially this use case was intended to only cover the pre-application and pre-submission phase of an application for long-term stay or residence. This might be expanded with support during and after the application (e.g. for renewal).
LTSTAY-3 Application triaging	Requests for long-term stay or residence are high and rising in volume and variety, and it is a complex task to appropriately assess categories of cases as it requires certain "local knowledge" (e.g. documents evidencing family links or professional qualifications from India compared to Egypt). Furthermore, governments are struggling to keep up with the number of requests and timely response regarding the enquiry.	**An AI triaging system could be implemented to automatically and rapidly identify standard applications and classifying more complex applications for human review.** Classifying means grouping similar applications (e.g. from a certain country or reason for travel) for review by a "SME" in experienced in a certain type of application. By grouping the applicants, the responsible officers would take save time in the 'basic' ones, and would only spend more time, in those that are classified as complex. Technical approaches would be similar to VISA-1 (application chatbot)
LTSTAY-9 Moving within the Schengen area	There are many cases where individuals who migrated to the Schengen Zone, decide to move to another EU member state after being granted their original permit. Moving to another member state will result in restarting the original application process. Because of this, it can be a challenge for these individuals to understand the process and find the relevant information and documentation again needed for the application.	**Use of a smart chatbot (or virtual assistant) which streamlines interactions for individuals who have already received permits for long-term stay in an EU member state**. Example features could be: efficiency between new applications via reuse of previously submitted documenst and information, answering questions such as application process queries, or other information provision such as work permit rules. The technical approach for a chatbot would be similar to VISA-1 (application chatbot). If the chatbot was used to facilitate a continuous experience, e.g. recommending relevant information based on personal data or historic questions asked, then it could incorporate wider functionalities like recommendation engines.
Initiative 4	**Granting international protection**	
ASYLUM-3 Vulnerability assessment	The first step when the authorities come in contact with undocumented migrants is to perform a 'vulnerability check'. This is to judge whether a person is in immediate danger or has special needs and/or should be granted special procedural guarantees, and this requires expertise and experience. The process being quite subjective sometimes is a challenge in itself, but also the capacity of these experts (e.g. trained social workers or case-workers) is a constraint on this sub-process which would be mitigated with efficiency improvements.	**AI to perform real-time analysis of an applicant's facial movements, spoken language and body language to detect signals which can better inform decision-making by a human social worker/specialised expert (e.g. if the person should be granted special procedural guarantees**). Techniques would seek to notice and assess the emotional cues implied by both what the applicant says/does and the way that they do it, either in terms of modelling apparent emotion types or by detecting fluctuating or unusual behaviour.

ID	Problem statement	Use case description
		In the asylum context, applicants commonly experience negative emotions when recalling traumatic past experiences. An intelligent AI seeking to identify specific issues such as torture/trafficking (possibly by attempting to link emotional cues with corresponding usage/sequencing of specific words and phrases) would be a more advanced use case than one providing more general information (identified and quantified emotional signals) or more generic signs of distress or abnormal patterns in communication. Analysing the content could use approaches like entity recognition or keyword detection, topic modelling or attempting to classify the specific emotion portrayed via sentiment analysis. Text-based approaches could also integrate with speech-to-text. Image-based analysis could be achieved by training a convolutional neural network on example images labelled with emotions, for example. Bringing visual analytics into the asylum assessment process also allows for additional AI models to be efficiently leveraged at this point in the modified process e.g. age discernment via facial image analysis (ASYLUM-4). Large technology companies including Amazon, Microsoft and Google are all developing AI in the area of emotion analysis, and it is gaining strong attraction in China especially, but overall it is a nascent technology.
ASYLUM-5 Registration chatbot	The registration of an applicant into the asylum process requires many steps and can be a slow process. Especially in a context of rising asylum seeker volumes, this leads to pressure on the system (long waiting lines, high workloads for processing etc.).	**Using of an AI chatbot to facilitate the registration process.** This would include the provision of information to an applicant to help guide them through the process, a data validation layer to ensure clean/correct data inputs from the applicant, and the triggering of automatic internal systems (such as booking interview slots, translators) which currently require manual effort. The chatbot would support the applicant by prompting for inputs (e.g. follow-up document requests) when required, and presenting a convenient channel to automatically deal with FAQ-type requests. If the applicant arrives with his or her family, the family members could be linked under the application. The chatbot could also be deployed in a training setting - facilitating 'virtual interviews' to familiarise trainee case workers with conversation scenarios. The technical approach would be similar to VISA-1 (application chatbot). The orchestration of downstream automation here could be augmented with additional AI to optimise resource allocation (a simple approach would be directly predicting capacity

ID	Problem statement	Use case description
		metrics with regression, while more advanced approaches could be reinforcement learning based, but these considerations would likely be separate from the chatbot core).
ASYLUM-7 Abscondment risk assessment	During the Asylum application process and the returns process, it is quite common that applicants end up absconding. Absconding during the return process creates difficulty in effectuating a return decision, creating the risk of secondary movements. Currently, there is no consistent method in place to proactively assess this risk. An applicant may be detained only : (a) in order to determine or verify his or her identity or nationality; b) in order to determine those elements on which the application for international protection is based which could not be obtained in the absence of detention, in particular when there is a risk of absconding of the applicant; (c) in order to decide, in the context of a procedure, on the applicant's right to enter the territory; (d) when he or she is detained subject to a return procedure under Directive 2008/115/EC of the European Parliament and of the Council of 16 December 2008 on common standards and procedures in member states for returning illegally staying third-country nationals, in order to prepare the return and/or carry out the removal process, and the member state concerned can substantiate on the basis of objective criteria, including that he or she already had the opportunity to access the asylum procedure, that there are reasonable grounds to believe that he or she is making the application for international protection merely in order to delay or frustrate the enforcement of the return decision; (e) when protection of national security or public order so requires; (f) in accordance with Article 28 of Regulation (EU) No 604/2013 of the European Parliament and of the Council of 26 June 2013 establishing the criteria and mechanisms for determining the member state responsible for examining an application for international protection lodged in one of the member states by a third-country national or a stateless person. (g) in accordance with Article 15 of the Return Directive 2008/115.EC (L. 348/98) if: (a) there is a risk of absconding or (b) the third-country national concerned avoids or hampers the preparation of return or the removal process. and only if no other less coercive measures can be applied effectively in a specific case,	**AI model to predict risk of an individual applicant absconding during review of application and the return process.** The ethical context of this use case means that the model should provide alerts or recommendations for further review - such as revealing patterns/trends in previously observed absconding examples and highlighting similarities with active cases. Based on these alerts on recommendations national authorities can then respond with measures such as detention or alternatives to detention. The decision for (alternatives to) detention must still be based on the individual, but the idea of the use case is to provide support to this decision-making process by presenting data-driven information which may not be immediately obvious to a human reviewer. The model would look at variables such as country of origin, previous application history, age, travel patterns, family members in another member state (potentially located with some kind of automated process attached to this use case). The technical approach would be similar to VISA-8 (to analyse travel patterns) and VISA-3 (application triaging) (to classify based on risk).

ID	Problem statement	Use case description
ASYLUM-11 Refugee allocation	For refugees, the integration process can be stressful and lead to significant changes in personal life circumstances. The need to find suitable employment after placement is, for example, a key consideration. Currently, allocation is not attempted in a particularly data-driven manner.	**Assigning individuals to be placed in geographic regions (at regional level within a MS) where they are more likely to find work and integrate smoothly.** AI would consider factors such as fit of skills into labour market, existing settlement of others from the same country of origin and aggregate flow levels of asylum seekers, in order to facilitate prediction of integration success, and facilitate decision-making by suggesting assignment recommendations (or streamlining presentation of relevant data in order for a human to generate their own recommendation). Similarly, AI could be used to place applicants arriving directly to the MS in a specific geographical area (for example where there is a large capacity of interpreters in a specific area). The technical approach for performing this allocation would be similar to VISA-3 (application triaging), because it is a similar classification-type problem. Instead of risk-based classification, here outputs would reflect potential allocation options. This use case would be similar to ASYLUM-13 (a similar analytics engine for assignment to detention centres) with aspects of ASYLUM-6 (a chatbot wrapper, to follow-up with individuals who have been granted international protection, monitoring success of integration and/or providing relevant follow-on information to individuals (e.g. local information)). A similar use case was developed by the Swiss Immigration Policy Lab, which has branches at Stanford University and ETH Zurich, and an affiliated researcher from Dartmouth College
ASYLUM-14 Intelligent search engine	The key question of the asylum procedure is to assess whether the asylum seeker could be returned to their home country. This decision is made on the basis of the perceived risk level for the individual from such a return. However, the potential consequences of return are not only examined in the asylum procedure; the obligation of non-refoulement must also be respected in alien policing procedures (e.g. when the person did not apply for international protection but comes from a war-zone; if the asylum procedure is ended with a rejection, but there is new evidence coming up during the return procedure). Therefore, it is ethically crucial that such a risk assessment is as accurate as possible, and that the appropriate outcome is achieved. A challenge is to correctly establish the identity and country of origin of the applicant through credibility checks.	**Intelligent search engine to assist with risk assessment of returns to origin country by compiling relevant country of origin information: locating documents, reports and other evidence**. The specific assessment of individual risk must remain a human activity, but AI can be applied to generate efficiencies by augmenting the human decision-making: for example generating extracts/summaries of the relevant country of origin information gathered from databases. Similarly, the AI could gather relevant case-law (leading cases, court decisions) and ensure consistency in the decision-making (see CROSS-7) By creating an engine which interfaces with country of origin data in this way, an additional functionality could be the automatic generation of country knowledge questions (credibility assessment tests) to be used in interviews. Since data is generally stored and

ID	Problem statement	Use case description
		labelled in some kind of text format, this use case would likely involve various NLP aspects. A common approach to knowledge management is to have a 'semantic layer' which assists with automatic meta-tagging to facilitate powerful user searching. Classification models like convolutional neural networks (potentially with forms of recurrent neural network for text (sequence) processing) could be used to further categorise documents, while generative models like transformers might be able to generate coherent summaries. The models could also learn from patterns in previous search behaviours. More advanced techniques might begin to incorporate other data storage formats, such as knowledge graphs. In this case, further enhancements powered by graph query language and algorithms for embedding and visualising data could be investigated. Various small and cloud providers offer AI-powered knowledge management services.
Initaitive 5	**Consultation of SIS and involvement of the SIRENE Bureaux**	
SISSIRENE-1 Alert detection	Nowadays, the search for a specific individual and the respective possible match with SIS happens on an ad hoc basis, when for instance a border guard recognises a flagged individual. However, this can be a difficult and inefficient task due to the difficulty in keeping track of the different individuals to be aware of and identify them. In fact, this process can result in failing to identify several wanted persons of objects, decreasing the overall security of the Schengen Area.	**Through the usage of cameras in border points an AI system would apply computer vision to detect SIS alerts - such as identifying a match on a target person or car number plate**. Nowadays, in order to have a hit on an alert, a given person or object have to be searched. In other words, it is only possible to get a hit if the names or biometrics of a given person are put against SIS. The system would capture the image of the border crossers and send a notification to a border guard if there was a match with an alert made in SIS. Then, the border guard would validate/verify the obtained match and perform the requested activity in the alert. From a technical AI perspective, computer vision for some form of object recognition would be deployed: this would commonly involve a domain-specific convolutional network (such as a network trained to recognise human faces). It could also incorporate aspects of optical character recognition. Object recognition is a well-researched and common AI application area, although less prevalent in this domain and in public usage. However in late 2019, the transport agency of the Australian state of New South Wales announced it had integrated computer vision into roadside cameras to spot offenders

ID	Problem statement	Use case description
SISSIRENE-4 Knowledge search / management tools	At the end of 2017, SIS contained approximately 76.5 million records, it was accessed 5.2 billion times and secured 243 818 hits (when a search leads to an alert and the authorities confirm it). Such a large database, containing many different kinds of documentation and information, is difficult for humans to search manually. This results into a greater FTE cost and lower user satisfaction.	**AI applied as a knowledge management layer to facilitate search and exploration of the SIS database.** The AI could be tailored to the user and their ways of searching, for example through a chatbot interface, and could work with a semantic layer to facilitate searching via natural language queries.
SISSIRENE-6 Automatic form completion	Filling in SIRENE forms requires to be done in a consistent and correct way, to ensure that the communication between member states happens smoothly. The officer needs to choose which form to use and then fill it with the correct information. However, in practice it is observed that not only the officers use the wrong forms, but also that these are not filled in accurately and require a lot of human effort and further interaction to correct them.	**Automated SIRENE form completion by using the information from the original alert alongside a report from an officer (highlighting the action taken).** An AI system could be used to automatically recognise key information from the alert, and to collect and structure information coming from an officer's report. Specifically, using natural language processing (NLP), the system would work as a virtual assistant to interact with the officer and gather the necessary information to automatically complete the SIRENE form determined to be correct. Then, this information would be sent to the other member state (perhaps with automatic translation to the correct new language). The technical approach would use techniques like entity recognition and 'spellcheck'-type functionalities as well as a chatbot interface, as described in VISA-1 (application chatbot) and VISA-9 (tailored application form) .
Initiative 6	**Border checks at the external Schengen borders**	
SCHENGEN-3 Triaging border crossings	There are around 600 million crossings at external borders of the Schengen Area each year. Each individual crossing means a decision for a guard – not only about whether to let a person in or out, but also to know whom to refer to the second line. That means deciding on who can directly cross the border, who needs to be further interviewed in second line, or even who should be referred to the competent authorities.	**AI model to triage border crossers into buckets to suggest a second-line action**, most likely due to historic trends based on the individual's risk profile (but could also incorporate external factors such as seasonality and macro situation). Specifically, the system would analyse the entering travellers, and would divide them into the ones that can proceed without passing by a second line border check, and those who should go by that extra check. This use case, will not be assisting in the final decision of who can and cannot enter/exit the Schengen Area, but rather recommend whoshould go by an additional check, based on travel patterns, external factors of the countries, individual profile, among others. The technical approach for triaging would be similar to VISA-3 (application triaging).

ID	Problem statement	Use case description
SCHENGEN-4 Border flow analytics	As mentioned throughout the description of the process it was mentioned that one of the process' pain points was the inability to carry out effective resource planning. It is a challenging task as having too many, or too few border guards may create risks at the border. Currently across many EU countries, this is done in an elementary way, with very few insights on the land borders.	**This use case is based on applying predictive analytics on the total migration flows in both land and air borders, in order to improve staffing planning**. By collecting enough insights on travel patterns and expected people flows, it is possible to reallocate border guards to ensure that at travel peaks there are enough borders guards to deal with a considerable amount of travellers, and in lower periods there are not too much officers. The use case would be driven by a model providing operational recommendations (or metric indicators) based on input data around travel statistics (it could use the API data for air borders, or even the number of cars/buses on the road driving towards the border). It could be approached as an end-to-end model, for example in a supervised approach attempting to draw correlations between people flow signals and positive historic operational decisions. Alternatively, it could be more modular: at a high-level, a regression model could be used to predict people flow volumes in certain areas, and a guard allocation model could then be trained on this data to optimise the number of guards on duty.
Initiative 7	**Operational management of services at eu-LISA**	
OPS-3 Incident prediction	The amount and complexity of support requests require a very large technical skillset to be dealt with effectively. Moreover, they also require a considerable amount of effort for understanding and solving. This results in an increase in the solving time of the incidents, as well as a risk for decreased availability of the systems due to longer time needed to solve and fix failures (for example due to incidents that are not timely addressed or that require considerable amount of effort and expertise).	**The objective of this use case is to analyse events within the monitoring systems, predict possible failures or incidents in the systems managed by eu-LISA (currently VIS, SIS and EURODAC but also the future systems such as EES and ETIAS) and reduce false positives and false negatives (i.e. significant events that are overlooked or receive delayed attention).** More specifically, by applying big data analytics and machine learning the system would be able to partially automate the process of event triage, fault identification and recovery. Ultimately this would lead to an increased availability of the systems, which is a top priority and responsibility of the Agency. Moreover, these would even generate faster resolution times, as well as a cost reduction in infrastructure maintenance as incidents can be treated more effectively or even before they occur. This would be done in practice by applying big data analytics to events collected from the systems, from systems and network metadata, from infrastructure performance metrics and from historical data. Depending on the format of monitoring data, different techniques would be investigated. For time series data (e.g. level of network usage, behaviour, abnormalities), deep

ID	Problem statement	Use case description
		learning models like recurrent neural networks (or variants like Long-Short Term Memory (LSTM) networks) could be used in combination with more traditional signal-processing techniques to train predictive models that can anticipate potential incidents based on (supervised) patterns in historic data or (unsupervised) outlier detection. Once an incident is automatically identified or even anticipated, the response could be suggested by a model trained on labelled data where the optimal next action (for a given signal pattern) is already known. I n situations with reduced training data of this kind, a model which has greater freedom to experiment with actions (e.g. a reinforcement learning approach) could eventually uncover the most optimal policy for recommending actions. Ultimately, the goal is to automate the process of fault identification and recovery to create a 'self-healing' effect. As an example of such possibility, in 2016, DeepMind used machine learning techniques to achieve a 40 percent reduction in the amount of energy used for cooling Google data centres.
OPS-5 Triaging chatbot for L1/L2	Currently, the eu-LISA helpdesk experiences a very high volume of requests expected to significantly increase with the new systems. This can creates inefficiency as first line service desk staff must spend time on simplistic requests. Moreover, the amount of incidents may also results in a considerable waiting time for the user who made the request. A significant proportion of technical incident tickets can filter through to the L2 service desk due to lack of resolution at L1.	**The objective of this use case is to reduce the burden on the service desks (L1 & L2) within eu-LISA.** Specifically, the goal is to improve efficiency for both internal staff (e.g. eu-LISA helpdesk) and external stakeholders (e.g. Member states). By improving waiting times and improved resolution time, ultimately "customer experience" will also increase. This use case would be performed by creating a chatbot, which supports L1-type questions. This would improve the ability of the L1 service desk as a whole to respond to tickets. To improve the service, this chatbot can be in different languages varying between the member states. On top of that, an algorithm that triages L2-type questions in categories and redirects them to the respective team of experts provides the opportunity to speed up the process. The technical approach for a chatbot would be similar to that in VISA-1 (application chatbot)).
OPS-7 Learning chatbot	Today's dynamic environment demands that everyone and every system is in permanent change. Thus, the creation of new systems and upgrades in the existing ones is something more than common. However, most of this processes require changes in the 'way of doing things'. These changes are not always well accepted or comprehended by the users of the systems, which end up generating several inefficiencies, at the least.	**This use case intends to speed up the learning process of various stakeholders by answering general questions related to different newly developed Core Business Systems at eu-LISA**. For example, carriers will be required to use ETIAS to check if a traveller has a valid document for travel. Similarly, border guards must be familiar with the ETIAS and EES when performing checks on TCN. As ETIAS will be a new system for these parties, it will require a bit of learning from their side. Thus, this use case intends to target these situations to

ID	Problem statement	Use case description
		improve their familiarity with the system, while providing any clarification needed. This use case would be achieved by creating a chatbot specific for each of the systems and tailored to the user. The technical approach to each chatbot would in general be similar to VISA-1 (application chatbot) but the knowledge and specifics of each would be dependent upon the system in question.
Initiative: 8	**EU policy making and enforcement**	
POLICY-2 Linking regulations	Given the volume of existing legislation, it can be complex for policymakers to take into account all relevant legal texts when developing new policy. More specifically, policymakers are not always aware of links between legal acts as they are not directly referred to by a certain regulation (because of an implied relationship). Moreover, because of repealed acts, links between legal acts can be broken but this may not always be obvious.	**AI to rapidly observe links between regulations, both direct or indirect (implied relationship), based on substance of the text.** The use case is designed to assist with the research and analysis necessary at the start of the policy making process. To analyse the substance of legal texts, AI can be applied to text and other formats, using techniques similar to ASYLUM-14 (NLP for identification of topics and/or labelling of documents). Domain specifics could also be incorporated here, for example training models on specific legal language. To capture other types of similarity, rules-based approaches could be used (for example creating logic for finding implied links between legal texts). The AI could also look at metadata associated with the various legal texts, for example presenting statistics around the volume or age of existing policy.
POLICY-5 Clustering regulations	Drafting regulation is an important but time-consuming task, as it requires research on similar and dependent regulations. As described, it can be complex for policymakers to take into account all relevant legal texts when developing new policy. It is also a non-trivial exercise to determine whether directives are properly transposed into national legislation by member states.	**AI to search for similar regulations based on substance and format**. The use case is designed to assist at the policy design and drafting stages of the policy making process. Similarly to POLICY-2, AI with NLP techniques (like those in ASYLUM-14 – intelligent search engine) would be used to assist with analysing the body of relevant legal texts. The analysis (and ability to determine similarities of regulation) would then be used to check for appropriate national transposition of directives. This use case would then also assist with the drafting of new documents by suggesting appropriate structures/templates to be followed (based on patterns observed in related legal texts) or mapping dependencies between regulations which must be observed. This would create a culture of re-use whereby the amount of work 'from scratch' required to draft new policy is reduced.

ID	Problem statement	Use case description
POLICY-8 Automated newsgathering	A vast amount of information is constantly being produced and published online. Moreover, many detailed studies (in various fields) are conducted each year by different parties (such as the EU institutions themselves). It is a sizeable task for policymakers to gather and analyse all of this information to identify apparent trends, let alone to determine insights relevant for policy making. True insights into social attitudes can be obscured by noise or bias (for example, mainstream topics and certain groups may be overly prevalent or vocal on online information sources; similarly, by applying human judgement to determine key topics, human selection bias is introduced).	**Use of AI natural language processing to analyse different public sources of information and discussion for identifying trends and insights (on topics relevant for policymakers).** AI would be applied to various sources like social media, news websites and (internal) report publications, and its outputs would provide additional input into the existing research process. The analysis would be designed to explore topics, viewpoints and questions; outputs could include lists of names (e.g. individuals mentioned in conjunction with a specific event), summarised articles or statistics measuring online engagement. Platforms commonly provide APIs for accessing data, and the use case would need to conform to the associated terms and conditions. Along with other relevant data, NLP techniques around topic modelling and summarisation would be used to uncover potential statistical discussion trends and revelations from the background of noise. This kind of task would most likely require an orchestration of various models, performing different analysis and classification tasks which would then be brought together (either in an automated fashion, or by a data scientist or policy expert) to determine the key insights. In order to guide the analysis, the AI could also be provided with information about the policy or stakeholder dynamics (for example from legislative text or structured stakeholder maps). The models should be able to look at a broad variety of sources to mitigate the risk of generating biased outputs.
POLICY-9 Effective stakeholder communication	EU procedures, new policies, and other EU-related activities can be complex to citizens and (small) businesses not familiar with the way of working. This can occur in various places: reports, presentations, digital channels, consultations, apps. For example, a citizen might look online to explore a large policy area with a lot of associated structured data and statistics, or to understand complex regulation in a specific situation. Without effective supporting explanation they may struggle to understand the information. In other words, there is a steep learning curve for various stakeholders who want to understand the EU practices and new policies. This results in a gap between policymakers and stakeholders, which can result in mistrust from its stakeholders.	**AI to facilitate in presenting and communicating new policies to citizens and business using data visualisation techniques**. This use case is a 'toolkit' of AI-enabled techniques which may be used, either by a human designer or in an automated way, to execute effective communication through visualisation. For substantive analysis (that is, analytical techniques which are applied to the meaningful contents of data), NLP techniques similar to those in POLICY-8 could be employed. But the focus of this use case is on the visualisation specifics; while statistics can sometimes mislead, data-driven perspectives can be illuminating as explanations. AI can be used to create individual visualisations or to assist with structuring an overall explanation (such as generating a sequence of charts to accompany a piece of text).

ID	Problem statement	Use case description
		For creating individual visualisations, toolkit components might use dimensionality reduction and clustering techniques to generate scatter plots or data point clouds. There are many open-source frameworks for creating other individual visualisations and diagrams. AI could also be used at a more structural level, to facilitate effective communication by deciding the most impactful and relevant diagrams from a given choice and context (e.g. predicting the axes data and chart type which should come af some text in a report). It could also look for patterns between different reports (or similar). A possible way to develop and distribute such a 'toolkit' could be through the open-source software ecosystem.
POLICY-12 Predicting policy acceptance	During the first phase (Preparation) different policy options are discussed to address the identified need. To assess these different options (and actions) impact assessments are launched to understand the implications (positive and negative) of a policy option. More specifically, it is often difficult to assess if a policy would be positively or negatively received by various stakeholders and by the broad public, independently of its possible adoption by the co-legislators. Furthermore, impact assessment studies are a (very) work intensive task and therefore it takes time to develop an accurate outcome.	**Use of AI sentiment analysis and sentiment prediction to assess if groups (citizens, businesses, etc.) will be in favour of (or oppose) a certain new policy.** This is to form a broad measure of approval which can be expected from external stakeholders (at consultation phase, say) and the general public. While a general background of socioeconomic statistics would likely feature as useful for modelling most policy scenarios, additional and up-to-date data gathering (using AI models like those in POLICY-8) might be used. For further modelling the response to the policy (i.e. the sentiment), it is likely that more nuanced models would be developed depending on the context. For example, to develop a picture of the response to a new policy from businesses, various data around investment and employment might like to be analysed in response to specific signals relevant to the policy context. However, a general core model could involve some kind of sentiment classification or general sentiment (polarity) score regression (i.e. a positive/negative scale).

ID	Problem statement	Use case description
Initiative 9	**Transversal processes and stakeholder opportunities**	
CROSS-1 Multi-lingual translation	When a TCN interacts with an EU member state or institution (for various reasons, such as request for a visa), it is possible that they do not understand any of the language options provided. Moreover, a case worker does not always know the language of the TCN and the documents provided by a TCN in context of an application (e.g. provision of birth certificate for requesting a 90-day visa). This can lead to delays in the applications, as it depends on the availability of different individuals such as a translator and the applicant or case worker.	**AI to provide multi-language translation for documents provided by the applicant and which need to be understood by an applicant or case worker (or other concerned party) during assessment of the case.** The technical approach would use optical character recognition and other document processing techniques to parse the input data. For example, a convolutional neural network or capsule network model might be trained to recognise certain components of a document structure. The core of the use case would be around machine translation techniques such as those in VISA-1 (application chatbot).
CROSS-6 Forged supporting docs detection	The process to detect fraudulent documents during a risk assessment is performed manually by a case worker, requiring significant expertise and experience. However, the manual process is subject to human error and can be very time-consuming (especially if reliant upon very specific local knowledge of certain documentation types).	**AI to detect forged supporting documents such as birth certificates or bank statements (note: this use case excludes travel documents)**. The model would attempt to identify documents, which appear fraudulent in various ways: for e.g. if the layout/format of a document is not of the expected type, if the contents of the document are not internally consistent, if the contents of the document are not consistent with other information provided. Examples of these types could be misplaced logos and sections (with respect to known examples), mismatched data in different locations (such as two different spellings), mismatched data in different documents (such as mentioning a different education background in a CV vs. in an education qualification document). To analyse documents in this way, text-based models and image-based models could be used together. For example, a convolutional neural network trained on an object-detection task might highlight a region of a document where a model for natural language understanding should be applied. Alternatively, models could be trained in supervised ways to give binary classification of real/fake. The model would seek to flag potential cases for human review, for example by highlighting which areas of documents should be investigated further. Advanced approaches here could include investigating the activations in a Generative Adversarial Networks (focused on the discriminator component) to see which pixels of an input image look the 'most fake' (i.e. contributed most significantly to the classification as fake).

ID	Problem statement	Use case description
CROSS-7 Historical case reasoning	As part of the decision-making process, case worker can appeal to case precedence by comparing equivalent decisions taken in similar cases. Moreover, consistent decision-making seems desirable and ethically fair. However, manually identifying cases that are "similar" in the right way is time-intensive and likely to be prone to error and inconsistency.	**AI case-based reasoning engine to analyse active cases by means of retrieving similar historic examples**. These are then presented to a case worker for review when making decisions about the pending application. Similarity can be based on the applicant profile, macro context, or more custom indicators, which might be developed internally. The tool could potentially include a dynamic self-learning module to learn from decisions. In other words, it would adapt the model using new knowledge received in the feedback cycle and take it into account when processing new applications. By flagging inconsistencies, case workers can be made aware of personal biases or identify general biases and receive appropriate feedback. The search component would use techniques similar to ASYLUM-14. The field of causal interference seeks to explore causal relations with machine learning and techniques in this field could be an advanced way to develop a reasoning engine beyond more typical classification approaches.
CROSS-8 Ethical monitoring	Member state systems are individually audited by EU workers to ensure that their AI systems are following the EU ethical guidelines. Moreover, currently there is no defined solution to monitor the future AI systems of the European Union. This is and will be a time-consuming task as it requires an in-depth analysis.	**AI for monitoring other analytics and AI systems to uncover undesirable trends, such as biased decision-making**. This could either analyse post-hoc results (to check for imbalances between various groups of data/individuals) or systems (for example applying explainability/interpretability techniques to machine learning models, to understand what kinds of variables are being considered significant for decision-making). AI tasks here could include outlier detection and other statistical testing (either automatically performed by AI, or having follow-up tests suggested in the case that issues are predicted to be possible but not checked directly).
CROSS-12 Forged travel document detection	Border guards are trained to identify stolen or forged documents. The references of stolen travel documents are reported in databases like SIS operated within the EU and SLTD (Stolen and Lost Travel Documents) operated by Interpol. However identifying forged documents requires expertise and experience, as the border guards must know the documents from all around the world and be able to distinguish a forged/falsified document from an original. Moreover, humans are subject to error and therefore it is possible that a traveller is able to pass the border with a forged/falsified travel document. This is even more problematic when considering the potential inconsistency in decisions made by different officers. Specifically, this could result in a situation where two forged documents are treated differently for the same procedure (request	**By using computer vision, an AI system can detect the use of forged travel documents.** To do so, it would analyse the captured image of the provided documents and assess if the physical characteristics of the document matches an original one, if the information provided in the documents is accurate, and the person providing the documents corresponds to the person in the document and is not a lookalike. The technical approach would be similar to CROSS-6 which is focused on supporting documents.

ID	Problem statement	Use case description
	for a permit, border crossing) and where one officer sees that the documents are forged and the other one does not.	
CROSS-20 Post application monitoring	Currently there is limited monitoring after issuing a permit to a TCN. In case TCNs abuse and/or do not follow the restrictions of the granted permit, this passes undetected as monitoring these conditions manually monitoring is a time-consuming activity. Moreover, the majority of the case worker effort is focused on delivering permits within a reasonable timeframe rather than on monitoring whether conditions on granted permits continue to be met.	**AI to scan and monitor different systems to assess if the conditions to which a permit was granted to a TCN still apply (the technical approach to this scanning could be similar to that described in VISA-3, application triaging).** The system would use the data from those systems to assess the probability of not complying with the conditions set when issuing the permit requirement after it has been granted. For example a TCN might receive a residence permit because of marriage with an EU resident. However, the couple could be separated soon after issuing the permit. In this case the conditions for providing the permit do no longer apply. The system would try to assess whether conditions for the permit issuance are still valid by analysing various sources of data (e.g. address or tax information) and provide insight on the probability of fraud. Another example is to monitor if a TCN is complying with the restrictions of the issued work permit, such as number of days worked. This could be checked by analysing tax statements. The AI deployed here could be overarching in nature – coordinating the 'search' for conditions by determining the most likely factors which should be checked, perhaps based on historic examples as correlated with the TCN's personal context (e.g. a certain number of years after marriage). AI could also be used to determine the substance of a given check – for example a specific model would be required in order to perform the aforementioned tax statement analysis.
CROSS-23 General EU chatbot	Citizens can feel detached from government institutions because of a knowledge barrier. This results in citizens not being aware of some of their rights and obligations. This is also the case for travellers who are only occasionally in the Schengen Area	**Use of a chatbot to support travellers (and citizens) with generic questions regarding the rights and obligations within the Schengen Zone** (e.g. right to work for a limited period of time and obligation to leave the country after 90 days within the Schengen Zone). The technical approach would be similar to VISA-1 (application chatbot).
CROSS-25 Biometric matching	Fingerprint matching has been used for several years within the context of the different systems managed by eu-LISA. However, even though its usage has experienced an exponential growth in the past few years, it still has to improve.	**The objective of this use case is to improve accuracy in biometric matching, more specifically for facial images.** Facial image is a new biometric identifier to be used in the context of the systems managed by eu-LISA, (either new or existing) together with the fingerprints.

ID	Problem statement	Use case description
	The technology has been used mostly for border surveillance and identity check within the borders domain. Important is that technology solutions are tailored to the specific situations in which they are used, as out of the box technology are often too simplistic which result in low accuracy. Reduced accuracy may also result from non-representative data used to train the biometric matching algorithms. Ultimately, this can lead to a decrease in the security of the Schengen Area, since suspicious people might could be escaping the systems. Moreover, this can also lead to inefficiencies in resource allocation, due to the false positives arising from a non-accurate system.	Depending on the origin and the physical characteristics of the third-country nationals registered and the specific algorithms used, more or less accurate results can be produced by the facial recognition system. The more data are registered, the more representative these are and the more prior knowledge is gathered (through the validation of hits taking place on MS side as well as through the continuous algorithm training over past cases), the more an algorithm can self-improve to increase its accuracy over time. The creation of a centralised biometric store including both fingerprints as well as facial images (future shared BMS) which will be used by different systems with different business requirements makes these opportunities for improvement of accuracy very important, considering also the complexity of assessing the combined accuracy of facial images vs the fingerprint matching. This would ensure that officers do not lose time investigating false positives and citizens are not unnecessarily stopped for a non-valid reason. This would be done by using state-of-the-art AI methods, refined for the specific context of eu-LISA systems and associated business processes. In particular, the use case would seek to add robustness and accuracy to existing biometric approaches. This could occur by: developing models to augment biometric data (e.g. by training a neural network to pre-process an image in such a way that the biometric information is enhanced) or developing models to directly perform or support the matching (e.g. with a convolutional neural network trained on face images). It could possibly include representative dataset generation to improve models in the absence of real training data (e.g. a Generative Adversarial Network could be used to synthesise artificial biometric data for training other models. Training data could also be augmented by applying image processing techniques like random rotations and adding noise; this would improve the breadth of training data and lead to development of more robust classification models).

Annex C | Methodology

This section details the analysis methodology which was followed throughout this study (to determine and prioritise AI opportunities).

Identify

In the Identify phase, expertise from AI practitioners is combined with domain knowledge (an understanding of the relevant processes, systems, data, regulation etc.) in order to uncover the full picture of potential AI application use cases. This is illustrated and described in more detail below.

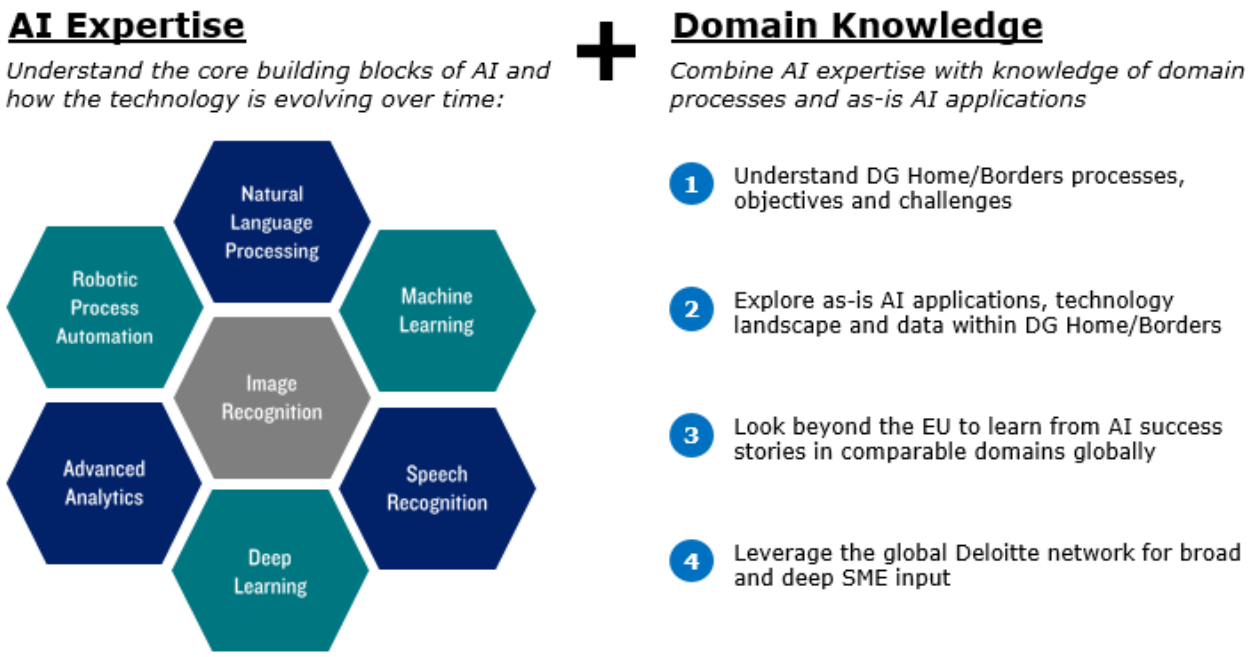

Figure 21: Illustration of concepts used in the Identify phase

In this study, the Identify phase was informed by 'pre-Identify' work including research into AI at the member state level, AI trends and developments in AI Ethics. This informed the identification and evaluation of the potential of AI opportunities, through appropriate lenses for human-centric ethics considerations and geopolitical perspectives.

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On the Domain Knowledge side – an initial discovery/process-mapping phase, combined with stakeholder interviews, allows a comprehensive picture of the current state to be uncovered. This happens within the project-defined scope. The analysis occurs through three main lenses, namely:

- Aspiration-led: "what are our goals and aspirations?". In the project context, this touches upon wider EU strategic context, and specific DGH objectives or KPIs for use of AI, and can be seen as more transformational thinking.

- Pain point-led: "which sub-processes show significant inefficiencies?". This can lead to incremental process improvement.
- Process-led: "which existing processes can be augmented or optimised using new technologies?". This can lead to new ways of looking at existing functions.

On the AI Expertise side – as well as bringing technical expertise from AI practitioners (consultants, solution architects, developers etc.) into the discussion, the framework also breaks down possible AI applications into the three main archetypes to guide discussion and analysis:

- Insight: Understanding structured and unstructured datasets, enabling predictions, uncovering structure, and facilitating decision-making.
- Engagement: Using intelligent agents to deliver smarter, more contextually relevant insights to amplify end-user experience.
- Automation: Combining "robotic" processing with AI technologies to automate end-to-end processes and repeatable decision steps.

Crossing the Domain and AI thinking together (for example: "which *process* inefficiencies can be addressed with *Automation* use cases?") during a series of collaborative stakeholder interviews allows for a comprehensive set of use cases to be identified. Outputs are typically presented in a table which sets out the use case in terms of associated process, sub-process(es), Problem statement and use case description, along with any further characterisations such as AI application type.

Prioritise

After identifying the universe of potential use cases, the Prioritise stage is the process of assigning each a relative Value and Feasibility score (1-5).

Each criteria has its own set of sub-questions which are explored during the scoring process. Scoring seeks to determine relative rankings of use cases, for comparative purposes, as opposed to objectively quantified metrics.

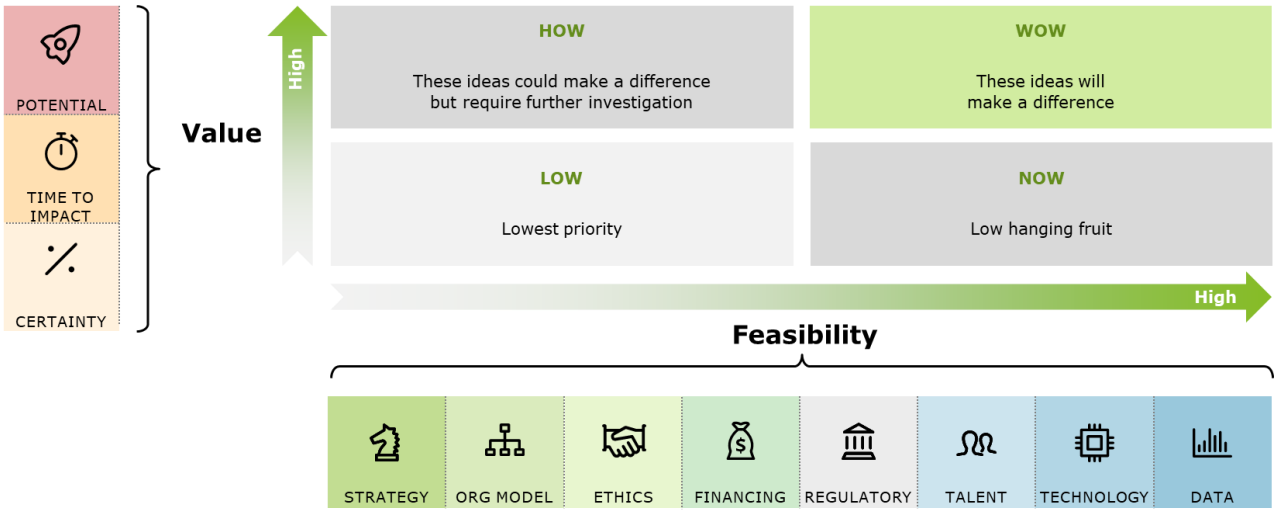

Figure 22: Illustration of the Prioritise framework used for comparing use cases in terms of Value and Feasibility

Value criteria

The Value score is determined by scoring across the multiple Value criteria:

- **Potential** – a measurement of overall potential impact (for example, improvement to a strategic KPI)
- **Time-to-impact** – a score capturing a sense of how quickly the potential benefits could be realised
- **Certainty** – a score capturing a sense of overall risk to benefits realisation, allowing for a conservative approach

Ethics criteria is also considered as a potential additional value criteria (specifically considered for this study due to the perceived aspirations of the EU at being a global leader in this regard). AI considered to be generating ethical outcomes presents an opportunity for DG HOME eminence, which could be considered part of the Value score; alternatively it may be preferable to explore this as a separate angle. Note that ethical value is separate from ethical feasibility, as the latter is more related to design or deployment constraints. An assumption that the development process (as in the roadmapping outputs of this study) would follow ethical guidelines is made.

Feasibility criteria

The Feasibility score is determined by scoring across the multiple Feasibility criteria:

- **Strategy** – a score capturing a sense of alignment to wider strategic goals
- **Organisational Model** – a score capturing how conducive the existing organisational structure might be to realising the expected value
- **Financing** – a score capturing capital/funding constraints
- **Ethical feasibility** – a score capturing ethical barriers to the use case which are separate from other criteria (e.g. the difficulty in using personal/private data would most likely fall under Regulatory scores, whereas other forms of misalignment from ethical guidelines would fall under Ethics here)
- **Regulatory** – a score capturing potential regulatory barriers and risks. More specifically existing regulation, adopted (i.e. what still needs to be implemented) and future (i.e. "what is expected") regulation is considered.
- **Talent** – a score capturing how well-equipped existing resource would be for developing this use case, or the difficulty in finding new resource
- **Technology** – a score capturing constraints related to existing systems, infrastructure and computing power
- **Data** – a score capturing constraints related to the volume, variety, veracity and velocity of relevant data assets

There may well be other types of feasibility constraints/risks that are not explicitly noted above; for example, implementation risks – but this is implicitly captured by other criteria (e.g. Technology, Data). Analysis of risks is also not limited to this part of the framework but should be prevalent during any stakeholder/SME discussions.

Assigned weighting

The quantitative scoring methodology outlined above is customised by applying (High/Medium/Low) weightings to the individual criteria outlined above to explore nuances in appetite. For example, applying a 'High' weighting to the Ethics score would make the Ethics criteria more significantly drive the overall Value score (hence making these use cases more likely to be taken forward to the next stages).

Weightings can also be adjusted during the Refine stage, to inform better cluster analysis (see next section).

Weightings were initially set by Deloitte, and iteratively agreed with project stakeholders for the purpose of use case scoring. Initial weights and associated rationale is provided below (note that Medium can be considered a neutral weighting):

- Potential: High
- Time-to-impact: Low – not seen as a major concern
- Certainty: Med
- Strategy: Med
- Organisational Model: Med
- Financing: Low – not seen as a major constraint in this context
- Ethical feasibility: High
- Regulatory: High – regulatory barriers seen as major constraints
- Talent: Low – not seen as a major constraint as difficulty to attract relevant talent is seen as systemic
- Technology: Med
- Data: High – seen as a major constraint as the first requirement for any form of AI implementation

After scoring and weighting, use cases can be compared and prioritised in terms of Value and Feasibility. It can be helpful to plot the scored use cases on a set of Value and Feasibility axes and to characterise each quadrant as illustrated above.

Refine

The Refine stage is about taking a prioritised shortlist of use cases and forming an opportunity portfolio which is balanced with respect to impact and requirements (from a more 'top-down' perspective than the previous 'bottom-up' stages). It requires close collaboration with domain and process stakeholders and takes the form of desk analysis, interviews and workshops.

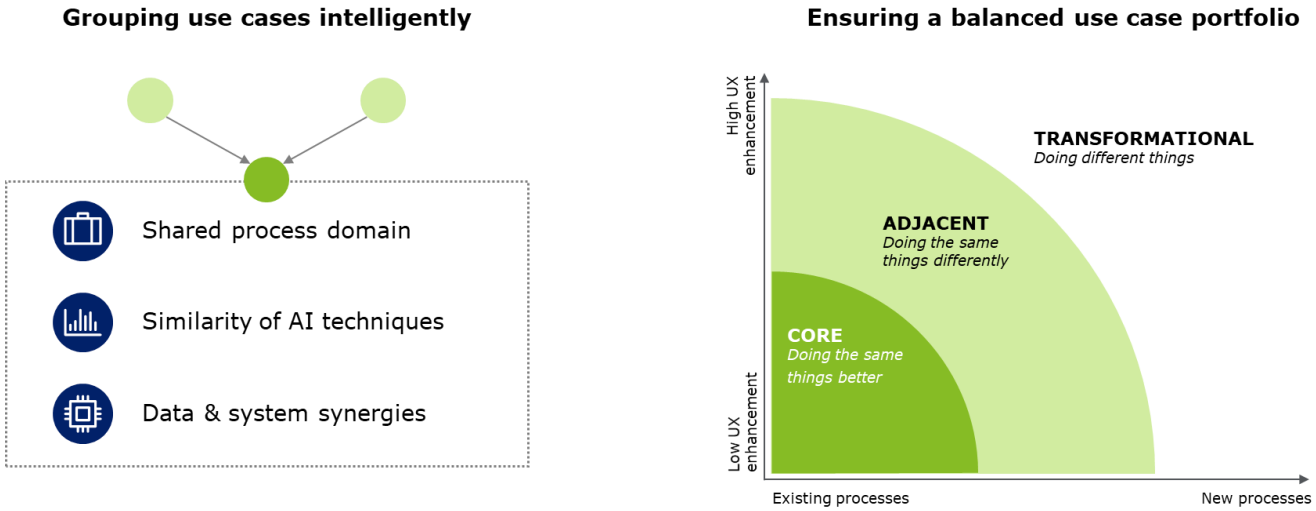

Figure 23: Potential analyses performed during the Refine stage

Outputs of the Prioritise phase undergo a number of analysis steps during the Refine phase (as illustrated above):

- Grouping use cases intelligently ('clustering') – assessing and aggregating use cases with respect to the criteria listed below. This may involve further iteration on the weighting criteria, in order to perform a robust exploration of the use cases; and, as such, it may be sensible to evaluate multiple cluster options:

- Similarity of process domain (e.g. a use case in the short-term Visa application process may bear similarities with a use case designed for the long-term stay application process, which can have implications for development and deployment)
- Similarity of AI techniques
- Data and system synergies

» Ensuring a balanced use case portfolio – assessing use cases with respect to the following impact criteria, to ensure opportunities taken further would drive transformational change (both external and internal) at appropriate scales. For example, an organisation might prefer to investigate a portfolio of mostly 'Core' opportunities (which are essentially incremental improvements), with some 'Adjacent' (moderate operational changes to existing processes and functions) and only a few 'Transformational' (disruptive shifts in operations, which are usually more aspiration-led):
  - Expected impact/enhancement on 'end-user' experience
  - Expected change to existing processes

In order to reach the desired output of a holistic opportunity portfolio, this stage may require iteration alongside the Prioritise phase.

Finalise

At this stage, prioritised use cases are each individually appropriate and (some) have been refined into an opportunity portfolio which is attractive when taken as aggregated initiative. Deeper analysis is developed, and work towards enabling initial solution development by producing various outputs (see below for illustrative outputs – these are not identical to those produced in this study).

*Per **each** prioritised use case for external and internal processes:*

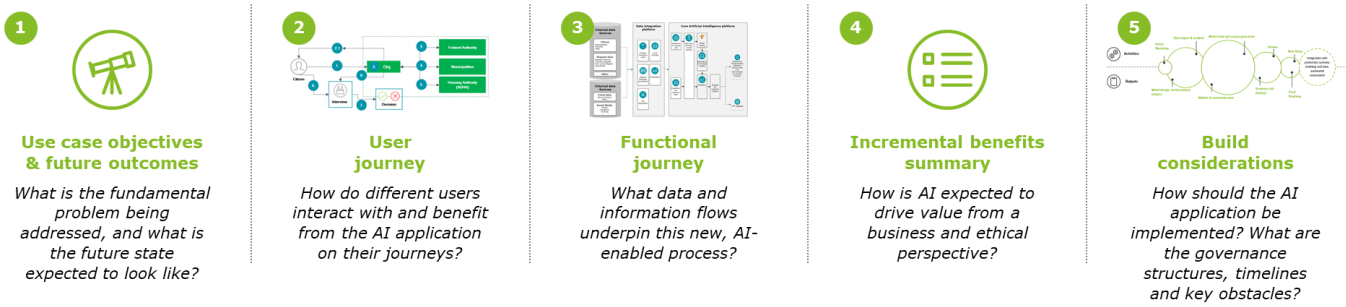

Figure 24: Per-use case outputs coming from the Finalise stage

There are various frameworks and analyses which underpin each of the outputs described above. For example, Build Considerations may be informed by proof-of-concept design principles for AI, if appropriate.

When developing User and Functional Journeys for complex processes and use cases, the typical approach is to assess a simplified flow which could be considered as 'the common denominator'. Alternatively, a scenario-based approach could be applicable, where analysis is performed under a selection of specified, representative assumptions which would be agreed with key stakeholders.

In addition to use case level outputs, analysis of use case groups and high-level governance considerations were produced.

Annex D | Table of acronyms

ABC	Automated border control
ABHED	Artificial Intelligence Based Human Efface Detection
ACM	Association of Computer Machinery
AED	United Arab Emirates Dirham
AGI	Artificial general intelligence
AI	Artificial intelligence
AIA	Alert Issuing Authority
ANI	Artificial narrow intelligence
API	Advance Passenger Information
ASI	Artificial super intelligence
AUD	Australian Dollars
AVATAR	Automated Virtual Agent for Truth Assessments in Real-Time
AWS	Amazon Web Services
BORDERS	National Centre for Border Security and Immigration
CAD	Canadian Dollars
CAGR	Compound annual growth rate
CEAS	Common European Asylum System
CNN	Convolutional neural networks
CSIRO	The Commonwealth Scientific and Industrial Research Organisation
DSS	Department of Social Services
EC	European Commission
EEG	European Ethics Guidelines
EES	Entry/Exit System
EGE	European Group on Ethics in Science and New Technologies
ENOC	Emirates National Oil Company
ETIAS	European Travel Information and Authorisation system
EU	European Union
EUR	Euros
GCP	Google Cloud Platform
GDPR	General Data Protection Regulation
GPU	Graphic processing units
GTAS	Global Travel Assessment System
HR	Human Resource
HTR	Hand Text Recognition
IEEE	The Institute of Electrical and Electronics Engineers
IRCTC	Indian Railway Catering and Tourism Corporation
ITI	Information Technology Industry Council
JAIC	Joint Artificial Intelligence Centre
KRW	South Korean Won
MEP	Member of the European Parliament
ML	Machine Learning
MS	member state(s)

MNCs	Multi-national corporations
NLC	National League of Cities
NLG	Natural Language Generation
NLP	Natural Language Processing
NSF	National Science Foundation
OECD	Organisation for Economic Co-operation and Development
PNR	Passenger Name Record
R&D	Research and development
RDIF	Russian Direct Investment Fund
RFI	Request for Information
RFP	Request for Proposal
RMB	Renminbi
ROI	Return on investment
RTA	Roads and Transport Authority
RUB	Russian Ruble
S&T	Science and Technology Directorate
SEK	Swedish Krona
SGD	Singapore Dollars
SIS	Schengen Information System
SLR	Swedish Land Registry
SLTD	Stolen and Lost Travel Documents Database
SNAP	Supplemental Nutrition Assistance Program
SME	Small and medium enterprises
SME	Subject Manner Expert
SURTRAC	Scalable Urban Traffic Control
TCN	Third-country national
TDAWN	Travel Documents Associated with Notices database
Trn	Trillion
TSA	Transport Security Administration
UNI	Union Network International
UNWTO	United Nations World Tourism Organisation
USCIS	U.S. Citizen and Immigration Service
USD	United States Dollars
VIS	Visa Information System
WEF	World Economic Forum

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