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Authors	Name	Organization/Unit
Main Author	Lukasz Szklarski	ITTI
Contributing Author(s)	Andreas Kriechbaum-Zabini	AIT
	Diana Dimitrova	ICRI/KUL

Approval	Name	Organization/Unit
Technical Reviewer	Günter Schumacher	JRC
Language Reviewer	James Ferryman	UREADSSE
Security Assessment	George Ion	RBP

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Authorization	Name	Organization/Unit
Project Officer	Valeria Bricola	European Commission

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Document Reviews

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1 Summary

Border control process must be heavily monitored to ensure a sufficient level of security. Monitoring of processes involved in border control also has secondary uses, including data gathering for analytics and improvement of processes. This document describes how the adaptive selection of monitoring techniques in the overall process of border control and sub-processes monitoring. Using a top-down, deductive methodology to scrutinize the current system outlook leads to recommendations of what monitoring techniques should be used and how. Harmonized processes are broken down using BPMN notation. For every sub-process isolated, all key events and their possible outcomes are recommended for measurement.

2 Introduction

2.1 Purpose of the Document

The Description of Work (DoW) for the project defines specific objectives that this deliverable has to fulfil regarding harmonized ABC gate processes, such as: border check process, gate surveillance process, traveller assistance process and quality assurance. The main objective is to enhance the overall efficiency of the system by improving proper running of processes through either reducing costs or shortening the average duration of an inspection, while keeping the quality intact – or even increasing it.

The underlying principle is to present guidelines for adaptive selection of monitoring techniques (meaning gathering adequate measurements and performing statistical calculations based on them) for all the processes. The main idea of these monitoring techniques is the adaptability of border management activities to seamlessly perform in different conditions and react to different situations. A justification and an explanation shall be presented of why the adoption of said monitoring techniques will in fact provide the promised outcome. These monitoring techniques are also going to be used during setting the thresholds of the calculated statistics. The thresholds will be used to decide what actions (=recommendations) should be taken in case of an atypical situation.

There are two generic examples from the DoW expanded here as how the recommendations provided in this deliverable would work and how they would improve existing processes:

I. Accelerating and optimizing the border processes through adaptive passenger/queue monitoring. The specific measures outlined in the breakdown of the harmonized processes (see chapters 5.1.1, 5.2.1, 5.3.1 5.4.1) can be used to actively enhance the understanding of what is happening in the specific point in the flow of the process. The measures used for that purpose may be, among others: number of travellers using ABC gates per hour, system errors during border check processes to successfully completed processes ratios, number and percent of sustained complaints for assistant's help, queue length, mean time between unsuccessful border

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checks, traveller type (e.g. EU/non-EU, registered in RTP or not) etc. Any problems that can be spotted earlier with the help of adaptive monitoring and the data gathering, and therefore problems detected earlier will not interrupt the proper running of a process or actors involved. In other words, better monitoring is one important step to achieve better and faster reaction to an unexpected situation (e.g. system error).

II. Accelerating and optimizing harmonized processes through passenger profiling. The adaptive monitoring techniques described in the process carry much more value to understanding the process than just simple trespassing detection. There are dozens of individual events that can be registered, saved and analysed thanks to those techniques. Events such as “Passenger in Schengen Information System”, “Visa invalid” or “Negative identity verification” suggest outright that there shall be extra scrutiny placed upon the travellers with those alerts (if found to be indeed justified). However, adaptive selection of monitoring techniques will allow for differentiation between passengers who failed e.g. border check process due to “Passenger in Schengen Information System”, from those who failed the process due to ABC system malfunction or external system timeout, as in both cases border check processes will be halted anyway in a similar way. This approach allows for rapid, precise dispatch of additional manpower to problematic areas. Also, this ensures increased comfort to travellers, as the ones that go through the checks flawlessly will be less often subject to bothersome manual controls.

To reiterate, this deliverable will show the recommended monitoring techniques, and how they could be used to improve harmonized processes. The purpose of monitoring techniques is to gather data, which is necessary for proper management and timely responses to any unexpected events The application of suggested recommendations in any processes is in the end realized by the triggered corrective actions of the border guard officials with the goal of ensuring a rapid and safe border crossing process. Actions like sending additional guards to a specific gate, profiling passengers actively to ensure highest safety, managing the queues by opening or closing gates – all of those would be performed quicker and therefore better, as the information regarding the current situation would be more precise.

Process monitoring (Figure 1) leads through gathering data to conclusions about the quality and progress of the process, and is a key component of troubleshooting. It helps to discover both current and future problems and to take corrective and preventative actions.

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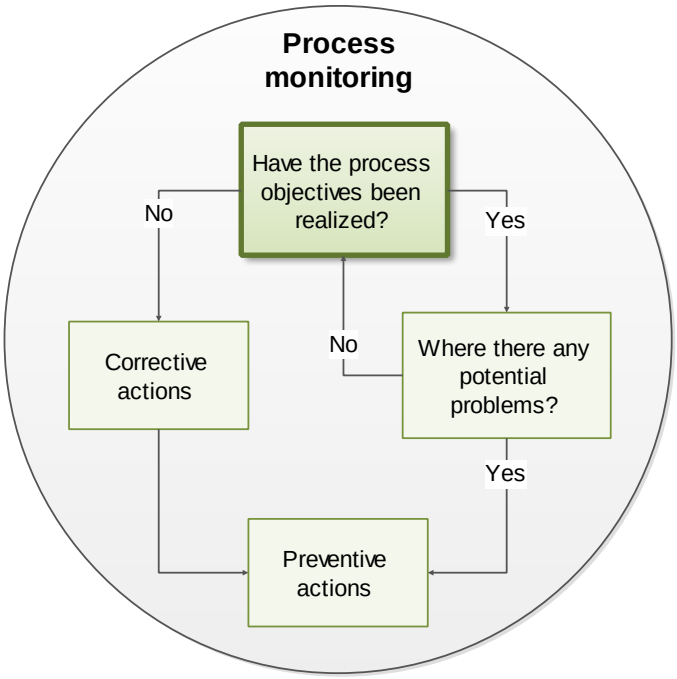

Figure 1 The idea of how every process should be monitored

The goals defined in the DoW are realized also by the measures, and recommendations attributed to specific values of those measures, although the recommendations are not binding. It also allows to establish adaptive criteria with thresholds individual to each and every border crossing. These thresholds shall be set in accordance with local or seasonal characteristics and induce changes in the procedures used. Those thresholds then become a part of the data interpretation system receiving input from the monitoring.

2.2 Definitions, Acronyms and Abbreviations

ABC (gate)	Automated Border Control
Accepted failure ratio	Number of incidents that is at an acceptable level and do not require additional action
Alert threshold	A level of alert occurrences, over which different, emergency protocols must be engaged
Border Guard	Public official assigned to a border crossing point or along the border or the immediate vicinity of that border who carries out border control tasks, in accordance with Community and national law
BPD	Business Process Diagram
BPMN	Business Process Modelling Notation
CBRN	Chemical, Biological, Radiological, Nuclear (hazardous material)
Failure	A process interrupted by an error (human, system)

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(process)	
Harmonization	Adjustment of differences and inconsistencies among different measurements, methods, procedures, schedules, specifications, or systems to make them uniform or mutually compatible.
Incident	An event that interrupts the standard flow of the process
optimization	Finding an alternative with the most cost effective or highest achievable performance under the given constraints, by maximizing desired factors and minimizing undesired ones.
RTP	Registered Traveller Programme
SIS	Schengen Information System
Success (process)	A process finished without any error (human, system)
Success to failure ratio	Number of travellers who finished the process to number of travellers who started the process in a period of time
TCN	Third Country National

3 Deliverable Description

The document consists of seven parts:

Chapter 1 - Summary

Chapter 2 - Introduction

Chapter 3 - Deliverable Description

Chapter 4 – Objective and methodology

Chapter 5 – Harmonized processes

Chapter 6 – Conclusions

Chapter 7 - Appendix

The most important, from the perspective of deliverable aim, is Chapter 5, which is further divided into harmonized processes. Sub-chapter 5.1 concentrates on border check process and its subsequent sub-processes. Those sub-processes include: monitoring techniques for border check, document authentication, enrolment (pre-registration), entitlement verification, identity verification and vehicle identification. Next, sub-chapter 5.2 Gate surveillance describes all the sub-processes responsible for ensuring security inside the gate and within a certain perimeter. Sub-chapter 5.3 is about assisting the travellers through the above processes in any possible way while ensuring safety and comfort. Sub-chapter 5.4 on the other hand depicts the processes of internal evaluation in regard to restricting access, gathering event and incident data and managing problems that occur.

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4 Objective and methodology

The Deliverable 8.2 based on the output of Task ST8.1.2, findings of WP5 concerning monitoring techniques and business processes described in D8.1. The idea of ST8.1.2 "Adaptive selection of monitoring techniques" is to improve the flow of travellers at border crossings, for example, by redirecting them to appropriate gates and timely reacting to any problems. For that reason, it is necessary to focus on harmonized processes, described in D8.1, that directly influence efficiency of border checkpoints. For that purpose, adaptive selection of monitoring techniques is required. Choosing appropriate monitoring techniques is bound to reduce time and cost of border control, whilst retaining the quality of checks. Appropriate techniques of monitoring should allow for optimization of queue assignment to reduce checking time. Therefore, monitoring techniques mean gathering adequate measurements and performing statistical calculations on their basis. Thanks to those techniques it will be possible to provide recommendations for adaptability of border management to react to different situations.

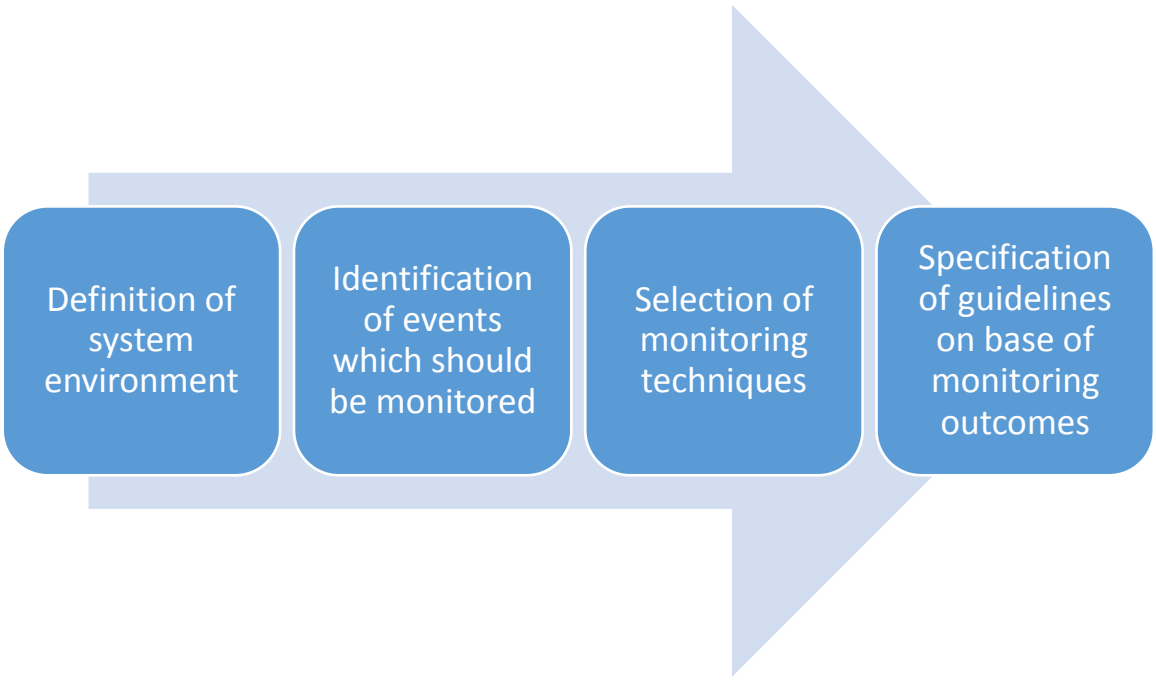

Figure 2 Method of analysis for the harmonized processes

For the proper realisation of the task, there is a need to view the harmonized processes from different perspectives, i.e. global (focusing on general processes) and detailed (focusing on sub-processes within processes). In this deliverable a top-down[1] method of analysis has been adopted. This means that one first checks how to

[1] The processes described in D8.1 have their own hierarchical structure therefore the top-down analysis was chosen.

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monitor general processes like border check or gate operation. Then monitoring techniques are identified for specific events[2] bounded with specific sub-processes[3].

In the first step, processes have been viewed from a holistic perspective. At this stage, the analysis concerning such aspects as general conditions (environment of FastPass system) in which processes occur was carried out. Provided in Chapters 5.1, 5.2, 5.3, 5.4 monitoring techniques allow to detect some important border management general correlations. For example, having information about flights (e.g. destinations), it is possible to determine, for example, whether travellers are traveling from countries where a visa is needed. Such knowledge, on the other hand, may be used to determine e.g. how many ABC gates should be open. Moreover, depending on the set it may be also possible to decide about using additional resources like guards, gates or cameras. Furthermore, statistical analysis could be used to analyse various trends and on the basis of received results, it may be possible to decide what actions (recommendations) should be taken, For instance, the analysis of type of travellers who use ABC gates can provide information what kind of travellers would require more attention from border guards, e.g. first time ABC gate users during summer season or high risk travellers (e.g. whose records have been found in SIS database). This kind of information could influence the number of operating ABC gates and supervising border guards.

In the next step, the focus was relocated to events occurring within harmonized processes. All events happening in every sub-process were identified and thoroughly analysed. Each process was briefly described and events that require monitoring were listed. For all processes monitoring techniques such as input/output ratio, mean event duration and functioning of a process were identified. Constant monitoring of document scan attempts, for instance, would allow a quicker reaction in case the scanner does not return information, the process takes too long or it is inactive at all.

The presented approach to monitoring would provide a great deal of information. Monitoring of different processes in real time allows for taking immediate decisions regarding, for instance, using additional resource (e.g. border guards or gates). All this would eventually lead to optimization of traveller flow and result in better organizing of processes.

5 Harmonized processes

To fully understand the inner workings of all the processes identified in the D8.1 an analytical approach has been adapted, and will be represented visually using a basic version of Business Process Modelling Notation (BPMN). BPMN is a notation that helps to illustrate business processes by using a set of elements organized into a

[2] Events represents the parts of the processes which are responsible for communications with other processes or external systems. Events are presented on diagrams representing sub-processes in D8.1 chapter 5.

[3] The process could be composed of other processes which are defined as sub-processes.

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diagrams called a Business Process Diagrams (BPD). It is a standardized, accessible notation for management personnel, analysts, developers and others. In the following chapter the basic rules of BPMN will be outlined to enhance the understanding of attached charts containing the processes and sub-processes important to this deliverable.

Business Process Diagram is created by combining a set of graphical elements into simple diagrams that look similar to a typical flowchart and is designed with simplicity and clarity, while explaining complex business processes. The set of elements is defined and consists of geometrical shapes and lines. The most basic elements are shown below and are further explained. This set of elements does not cover the complete set of available elements but is sufficient to navigate through this deliverable.

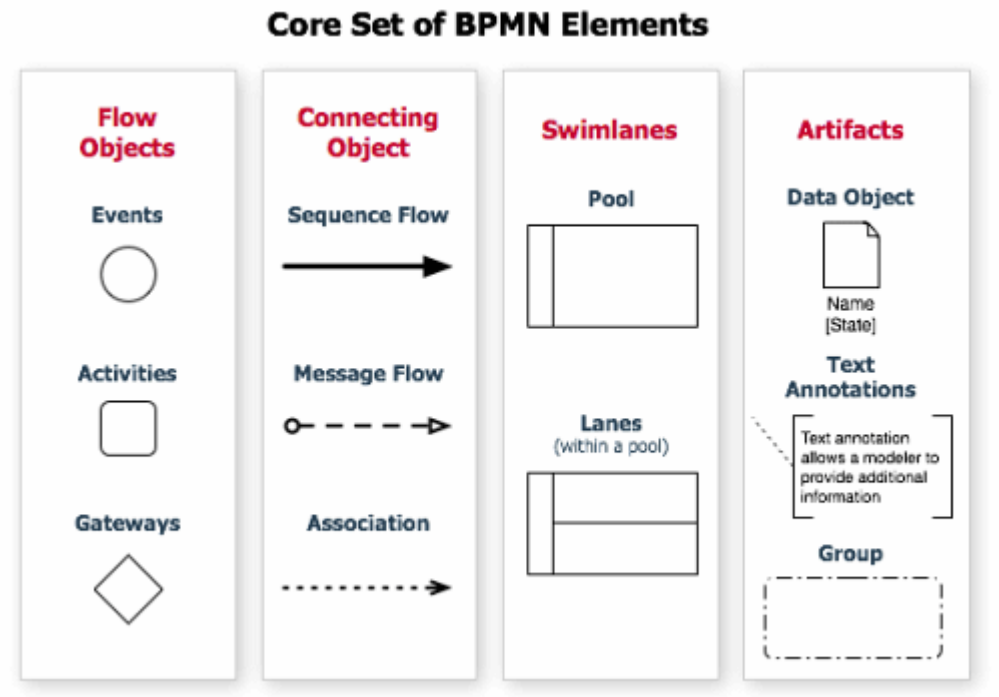

Figure 3 Core set of BPMN elements

Flow Objects:

- Events – represented by a circle, is a generic term for a thing that happens during the course of a business process. Events are changing the course of the process and usually have a “trigger” and an “impact”. There are three main types of events, differentiated by when they affect the flow: Start, Intermediate, End, as represented accordingly below:

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This deliverable also contains special event types:

- Error (lightning bolt), which means that an error has occurred,
- Message (envelope) which means that a message from a participant has been sent and it triggers an event.

Both can be in bold, which means that this event is concluding a specific part of the flow.

- Activities – represented by a rounded-corner rectangle, is a specific "work" that the actor of the business process executes as the part of the flow. There are two types of activities, Task and Sub-Process. Sub-Process is distinguished by a plus (+) sign at the bottom of the shape.
- Gateways – represented by a diamond shape, are the places where the Sequence Flow joins or splits. "Join" Gateways have a plus inside, while those "linking" multiple event have a pentagon inside.

Connecting object:

- Sequence Flow – represented by a solid line with a solid arrowhead, is used to present the order of the activities in the process.
- Message Flow – represented by a dashed line with an empty arrowhead and an open circle. Show an exchange of information between actors.
- Association – represented with a dotted line and a linear arrowhead. It is a way of linking specific artefacts with objects in the flow.

Swim lanes:

- Pool – is representing an actor in the process. Also used to separate activities by the participant.
- Lanes – are separated partition within the pool and is used to separate and organize activities.

Artefacts:

- Data Object – presence of this sign means that additional input in form of some data is needed or that it is produced by some activities.
- Annotation – allow for additional text description for the reader.
- Group – does not affect the flow, but is used for analysis and categorization purposes.

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The explanation of these BPMN symbols is also provided on Figure 4 Example sub-process visualized with BPMN example All notations got number assigned, which are explained on legend below Figure 4 Example sub-process visualized with BPMN example

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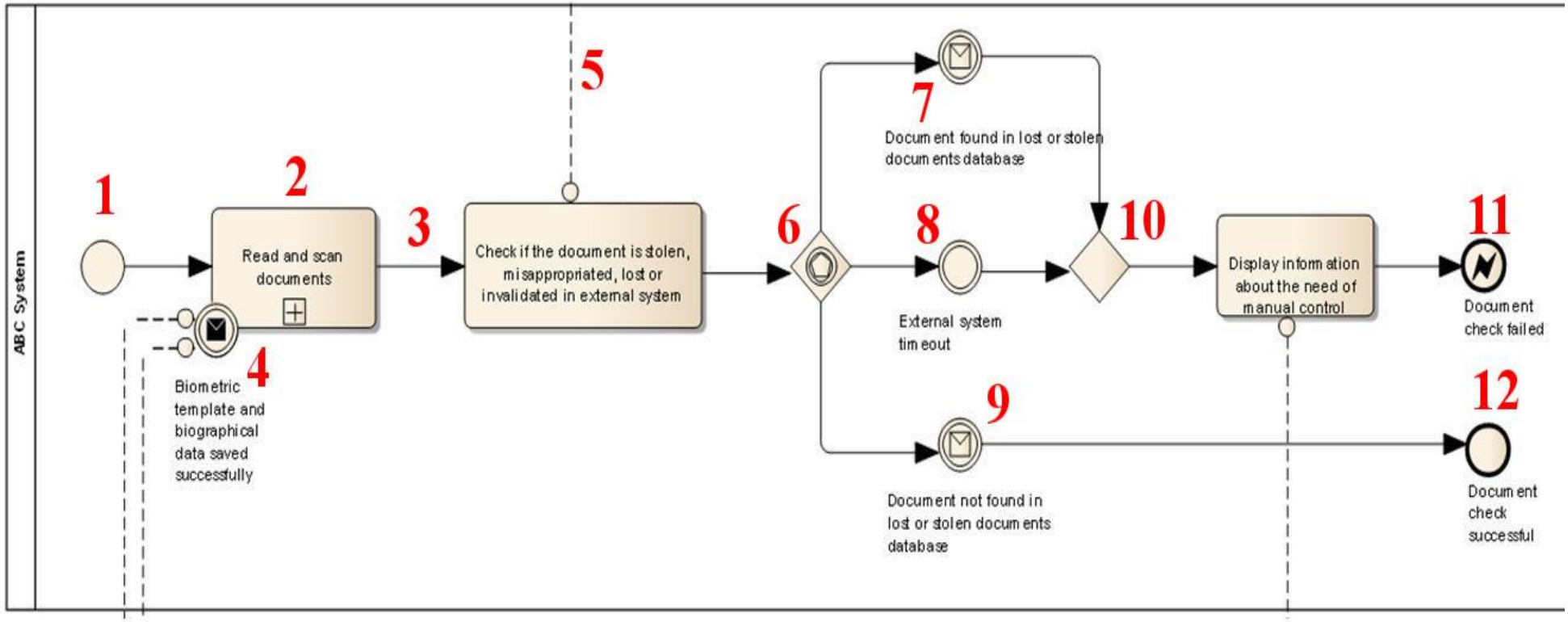

Figure 4 Example sub-process visualized with BPMN example

1. Start Event 2. Activity (Sub-Process type) 3. Sequence Flow 4. Message sent (concluding flow) 5. Message Flow 6. Multiple flows Gateway 7. Message sent (flow continues) 8. Intermediate Event 9. Message sent (flow continues) 10. Gateway (join) 11. Error event (concluding flow) 12. End Event

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The presented figure illustrates an example of sub-process that is analysed using BPMN. Every such sub-process will be shown in this fashion with an identical set of notations used for clarity and easier navigation.

For the entire document and every process, two general monitoring techniques are hereby provided, as they can apply to all of the processes:

- **measuring the ratio between successful and failed sub-process**; In every particular instance of sub-process failure (in most cases failure means producing end event with "lightning bolt " icon which represents an error during execution), it is registered and juxtaposed with the total number of sub-processes started. It reveals the ratio of processes started and processes halted. This ratio may be used as an overall grade of the system's efficiency, although it still does not differentiate the reasons of the malfunctions, and therefore has to be treated only as a supplementary source of knowledge, unless the reason for the abnormally high ratio is well understood. For example, a document authentication sub-process may be hindered by both token malfunction, misuse or invalidation, and malfunction of the read-out devices. Different responses are needed to those situations.
- **meantime between events and various correlations**; Another supplementary measure of the event's success is the mean time between incidents, that indicates how often does a malfunction (malfunction is represented mostly by timeout events) happen. The longer the meantime, the better the system performs. If the time between failures is very short, or in consecutive events, it might be due to technical infrastructure collapse. If the mean time is long, but errors still occur, it may be coincidental, since failures were separated from successful events. Therefore, this measure cannot be used as a system health check exclusively, as it still might happen that for example a very inexperienced group of travellers has caused multiple missed read-outs in a row. Therefore, further investigation into the mean time between incidents shortening has to be performed.

Every border crossing institution is free to establish its own alert thresholds to the said malfunction ratio. It is strongly advised to establish different warning levels with appropriate reactions attributed. Some levels of the malfunction ratio may indicate a critical system failure to which an emergency response is needed.

Since, there is no universally accepted level of incidents per every event (i.e. document scan, token scan), every institution is advised to set up its own guidelines to the subject. It has to take into account local characteristics and passenger flows. For example, airports that are seasonal tourist destinations (especially popular among the elderly), have to know that failure rate stemming from passenger inexperience using for example the ABC gates will be higher and this is not a sign of system malfunction. Therefore, a

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higher accepted failure ratio shall be set up for the holiday season to avoid alerts to which reasons are well known and are not abnormal. A mean failure ratio for particular seasons, months or even days may be set up – possibly, on Mondays more tech-savvy businessmen travel more often to and from this airport and are more fluent with border check technology than Friday weekend tourists. Charter flights are usually more tourist-oriented, so passengers travelling by them are more likely to be inexperienced. The period used to establish accepted ratios should not be excessively long, as regional characteristics change often, like the rising and falling popularity of the airport region as a tourist destination. The border crossing officials are in the best position to make judgments in this matter.

5.1 Border Check

The procedures of the “Border Check” process are split into five separate sub-processes that are in different cases either independent, or dependent on each other. Figure 5 presents interdependencies between sub-processes.

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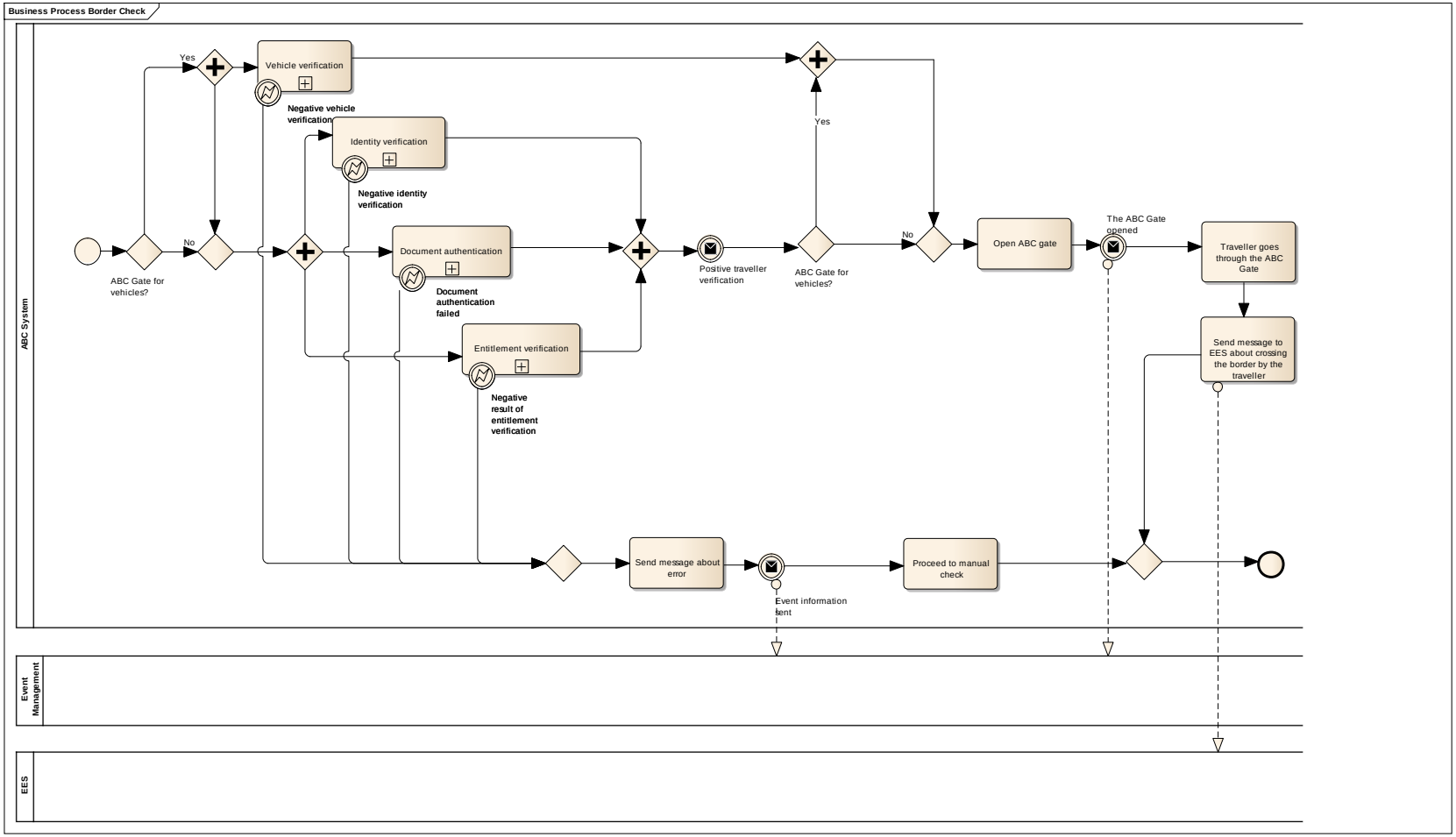

Figure 5 Border check diagram [source: D8.1]

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The following chapter details the main structure and lists the events that are key to the process. A summary table (

Table 1 Border check process structure outline

) is presented, which both outlines the process structure and allows for easier navigation between the tables in search for a particular set of information regarding one of the sub-processes. Furthermore, the specific monitoring techniques for adaptive selection are presented in correlation to the sub-process itself.

Table 1 Border check process structure outline

Event	Sub-process	Chapter contains detailed information	Monitoring techniques
Border check interrupted	Document authentication	Chapter 5.1.2	• Success and failure ratio • Mean time between failures
	Enrolment (Pre-registration)	Chapter 5.1.3	• Success and failure ratio • Mean time between failures
	Entitlement verification	Chapter 5.1.4	• Success and failure ratio • Mean time between failures
	Identity verification	Chapter 5.1.5	• Success and failure ratio • Mean time between failures
	Vehicle verification	Chapter 5.1.6	• Success and failure ratio • Mean time between failures • Correlation

The sub-processes measures are subsidiary to the grading of the whole process. If the main measuring factors of the border check process are negative, the troubleshooting can use the additional monitoring techniques provided to assess the probable cause of the malfunction or increased latency in the process. For example, some sub-processes are of such a key importance, that they will derail the whole border check process should they fail. Therefore, the whole set of measures regarding the efficiency of border check will be low or critical. Some sub-processes may not have such a strong impact on the whole process, yet for the efficiency of the border check must be kept at an acceptable rate of failure. For example, some older documents, especially those in a sub-par condition, may not be easily recognisable and scanable to the read-out devices of some types. In such cases manual control will, in most cases, need to be performed.

To sum up, border check process efficiency is determined by many sub-processes that can be independently measured. The whole set of measures reveals an overall health

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status of the system. Subsidiary values of sub-process efficiency measures are a part of establishing an overall grade for the process.

5.1.1 Monitoring techniques for border check

The following measuring methods have been suggested for the border check process. For individual set of sub-processes similar lists were prepared.

- **Determining the border-cross load and interest in using ABC gates:**
  - Number of travellers using ABC gates per hour (week, month, etc.).
  - Number of travellers who successfully finished border check process per hour (week, month, etc.).
  - Number of travellers using ABC gates to error ratio.
  - Percent of Third Country Nationals using ABC gates.
  - Percent of EU citizens using ABC gates.
  - Number of people with visa to overall number of ABC gates' travellers.

The above statistics will be useful to monitor border cross traffic and performance. They should provide information about the situation at the border crossing in real-time as well as include statistics gathered earlier. Due to this approach, border guards will be able to predict hours of the biggest load and thus - plan some actions (e.g. more border guards on duty during high traffic hours to make border check process as quick as possible). Moreover, these ratios will be also useful when determining the type of travellers using ABC gates. Establishing this ratio will be the first step of evaluation, e.g. low interest of ABC gates in some groups of travellers and will be valuable information during ABC gates improvement.

- **Success and failure ratio[4] –** monitoring of gate functioning:
  - Number of travellers who finished border check process to number of travellers who started border check process in some period of time (e.g. per hour, per day, per month, etc.).
  - Interrupted border check processes to overall border check processes ratio.

[4] Please note that failure means not only technical malfunction but in most cases not finishing the process with positive result e.g. document authorization failed in the document authorization process. On the other hand the positive result of that process will be "document check successful".

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- System error during border check processes to successfully completed processes ratio.
- Human error during border check process to successfully completed border check process.

In regard to those measures, a success could be viewed as a spotless progress through the whole course of the process, with the traveller having all the necessary entitlements, documents etc., and causing no special incidents during the process. Failure, which is not binary, can range from a total malfunction in the processes that makes the border crossing impossible for any reason – either on the passenger, or the border crossing side - to slight inconveniences that are to be simply ironed out. Failure and success are interdependent and higher failure rates mean diminishing success rates.

Therefore, success could be defined as a finished process, without any human or system error. For example, if a traveller would not be allowed to cross the border for some reasons, but they would finish the process – it is considered as a "success". According to this, we could define failure as a process interrupted by some human or system error.

Provided statistics are a useful tool to measure general performance of a gate - its efficacy and failure ratios. The two last ratios could be helpful in case of high error ratio, because according to them it will be possible to monitor if it is the consequence of human or system errors.

When statistics provide information about a large number of system errors – that would be a sign, that e.g. system is overloaded or some devices are damaged, thus there is a need to make some changes in the infrastructure of ABC system. For flow optimization it might be necessary to temporary redirect passengers to other gate (if it is an error of only one gate) or to manual control (if it is an error of all automated gates).

However, if the human error ratio is high, then making some changes with labelling should be considered. It is really important, because most of all - system is designed to save time. Therefore, ABC gates must be user-friendly and intuitive.

- **Mean:**
  - Number of travellers who finished border-check process (per hour, day, week, etc.) in one gate (mean time of the border check per one person).
  - Mean time of recovery after an error.

Measuring mean time of the border check for one person could be useful for establishing reference time setting. That would allow extracting knowledge from data about deviations from the norm, which can be symptoms of traveller who needs help or might be potentially dangerous. Therefore, it is a sign for border guard to control the ABC gate.

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Monitoring the mean time of recovery after different types of errors will prepare border guards for this kind of situations – they will be able to estimate, how much time, human resources etc. should be used to repair the ABC gates system.

- **Mean time between events**:
  - How often per some period of time human errors happen.
  - How often per some period of time system errors happen.

This ratio can be a tool for determining some norm of failures (especially for human errors). Exceeding this standard in some measured periods of time should be a sign for border guards to react.

- **Correlations between:**
  - Time of a year and human error ratio - this would allow to predict number of border guards needed for particularly period of year (e.g. higher error ratio during holidays).
  - For air border: type of flight and human error ratio.
  - Number of travellers per hour and system error ratio – this would provide information about properly database respond time.

Due to these ratios, by using the machine learning algorithms it would be possible to estimate number of border guards and opened ABC gates needed for: particular day or other periods of time (e.g. during holidays there will probably be more first-time travellers) and type of flights (e.g. higher error ratio when there are more charter flights, because of less experienced travellers). This statistics could be used for flow optimization.

5.1.2 Document authentication

Table 2 Document authentication events

Trigger event	Impact event	Reason it failed	Recommendation
Document check successful	The process may proceed to the next event uninterrupted		
Document check failed	Document authentication failed	Document scanned incorrectly in the document reader	• Communicate: “Incorrectly scanned document, please try again” • If it is not helping – then direct border guard

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Trigger event	Impact event	Reason it failed	Recommendation
		Document is illegible or damaged	• Communicate: “Please, verify if the document is not creased and try again” • If it is not helping – then direct border guard to provide manual control
		Document is false or not valid	• Direct border guard to verify that
		ABC Gate error occurred	• Redirect traveller to another ABC Gate or • Direct border guard to provide manual control
		System error occurred	• Redirect all travellers from ABC Gates to manual control and • Direct border guards to provide manual control
	Visa authentication failed	Visa inserted incorrectly in the document reader	• Communicate: “Incorrectly inserted document, please try again” • If it is not helping – then direct border guard
		Visa is illegible or damaged	• Communicate: “Please, verify if the document is not creased and try again” • If it is not helping – then direct border guard to provide manual control
		Visa is false or not valid	• Direct border guard to verify that
		ABC Gate error occurred	• Redirect traveller to another ABC Gate or • Direct border guard to provide manual control
		System error occurred	• Redirect all travellers from ABC Gates to manual control and • Direct border guards to provide manual control
	Token authentication failed	Token inserted incorrectly in the document reader	• Communicate: “Incorrectly inserted document, please try again” • If it is not helping – then direct border guard

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Trigger event	Impact event	Reason it failed	Recommendation
		Token is illegible or damaged	• Communicate: "Please, verify if the document is not creased and try again" • If it is not helping – then direct border guard to provide manual control
		Token is false or not valid	• Direct border guard to verify that
		ABC Gate error occurred	• Redirect traveller to another ABC Gate or • Direct border guard to provide manual control
		System error occurred	• Redirect all travellers from ABC Gates to manual control and • Direct border guards to provide manual control

For that sub-process the following could be monitored:

- **Success and incidents ratio -** higher failure ratio indicate low gate efficiency:
  - positive to negative document authentication ratio and negative to overall document authentication ratio – this would provide information about the general performance of the gate,
  - system error during document authentication to successful document authentication ratio – it would provide information about infrastructure's quality of the ABC gate system,
  - human error during document authentication to successful document authentication – it would provide information about ABC gate system's usability.
- **Mean time between unsuccessful border checks:**
  - too many negative document authentication messages in e.g. 1 minute means that border guard assistance is needed,

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- many negative document authentication messages will allow to establish some threshold[5].

Success – defined as a finished process, without any human or system error. If traveller would not be allowed to cross border for some reasons, but he would finish process – it is considered as a "success".

Failure – defined as a process interrupted by some human or system error.

5.1.3 Enrolment (Pre-registration)

Table 3 Enrolment events

Trigger event	Impact event	Reason it failed	Recommendation
Positive identity verification	The process may proceed to the next event uninterrupted		
Negative identity verification	Negative result of biometric comparison	Biometric template not received	Repeat process of biometric data collection
The biometric data successfully captured	The process may proceed to the next event uninterrupted		
Failed to capture the biometric data	Failed to capture the face/iris/ fingerprint	Biometric data not captured correctly – system failure	Face/iris/fingerprint scanning camera may need maintenance to properly capture biometrics • Redirect travellers to other e-gate • Start the process again
		Biometric data not captured correctly – traveller's mistake	A traveller may not stand in the right position: • Border guard assistance needed • Repeat action of collecting biometrics
Document check successful	The process may proceed to the next event uninterrupted		

[5] These thresholds shall be set in accordance with local or seasonal characteristics and induce changes in the procedures used. Those thresholds then become a part of the data interpretation system receiving input from the monitoring.

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Trigger event	Impact event	Reason it failed	Recommendation
Document check failed	Document found in lost or stolen document database	The document was found in stolen, misappropriated, lost or invalidated in an external system	• A traveller shall be halted • Border guard assistance is required
	External system timeout	Technical issues	Maintenance and IT services are to ensure that the time-out message is certainly caused by outside systems by checking internal systems. A query should be sent to the external system operator to inform about the malfunction, as the cause possibly lies inside the external system, not the communication between systems
	Document authentication failed	Document scanned incorrectly in the document reader	• Communicate: "Incorrectly scanned document, please try again" • If it is not helping – then direct border guard
		Document is illegible or damaged	• Communicate: "Please, verify if the document is not creased and try again" • If it is not helping – then direct border guard to provide manual control
		Document is false or not valid	• Direct border guard to verify that
		ABC Gate error occurred	• Redirect traveller to another ABC Gate or • Direct border guard to provide manual control
		System error occurred	• Redirect all travellers from ABC Gates to manual control and • Direct border guards to provide manual control
	Visa authentication failed	Visa inserted incorrectly in the document reader	• Communicate: "Incorrectly inserted document, please try again" • If it is not helping – then direct border guard

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Trigger event	Impact event	Reason it failed	Recommendation
		Visa is illegible or damaged	• Communicate: "Please, verify if the document is not creased and try again" • If it is not helping – then direct border guard to provide manual control
		Visa is false or not valid	• Direct border guard to verify that
		ABC Gate error occurred	• Redirect traveller to another ABC Gate or • Direct border guard to provide manual control
		System error occurred	• Redirect all travellers from ABC Gates to manual control and • Direct border guards to provide manual control

For this sub-process the following could be monitored:

- **Success and failure ratio** - higher failure ratio indicates gate low efficiency**:**
  - positive to negative identity verification ratio and negative to overall identity verification ratio – this would provide information about the general performance of the gate. For that purpose the number of "Failed to capture the biometric data" will be measured,
  - positive to negative document authentication ratio and negative to overall document authentication ratio – this would provide information about the general performance of the gate,
  - system error during document authentication to successful document authentication ratio – it would provide information about infrastructure's quality of the ABC gate system,
  - human error during document authentication to successful document authentication – it would provide information about ABC gate system's usability and reliability.

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- **Mean time between unsuccessful identity verification**:
  - too many negative identity verification messages in e.g. 1 minute means that border guard assistance is needed,
  - many negative identity verification messages will allow to establish some threshold
  - too many negative document authentication messages in e.g. 1 minute means that border guard assistance needed,
  - many negative document authentication messages will allow to establish some threshold.

Success – defined as a finished process, without any human or system error. If traveller would not be allowed to cross border for some reasons, but he would finish process – it is considered as a "success".

Failure – defined as a process interrupted by some human or system error.

5.1.4 Entitlement verification

Table 4 Entitlement events

Trigger event	Impact event	Reason it failed	Recommendation
RTP, SIS, VIS, EES, External systems check all positive	The process may proceed to the next event uninterrupted		
Negative entitlement verification	Technical issues	External system timeout	Maintenance and IT services are to ensure that the time-out message is certainly caused by outside systems by checking internal systems. A query should be sent to the external system operator to inform them about the malfunction, as the cause possibly lies inside the external system, not the communication between systems
		Internal software or hardware malfunction	Maintenance and IT services are to ensure that the time-out error is internal and shall perform a system health check and remove the cause of the problem

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Trigger event	Impact event	Reason it failed	Recommendation
	Visa not found in VIS, Traveller not found in RTP, Traveller ineligible to cross the border per EES, Traveller data found in SIS, External local systems claim traveller's ineligibility to cross the border	Traveller might not be entitled to cross the border	Refer the traveller to manual control to double-check their entitlement status. If truly ineligible, traveller cannot cross the border. If found eligible by double checking external data, they may proceed to next steps

For that sub-process the following could be monitored:

- **Success and failure ratio** – higher failure ratio indicate low gate efficiency:
  - Positive to negative entitlement verification ratio and negative overall entitlement verification ratio – this would provide information about general performance of the gate.
  - System error during entitlement verification to successful entitlement verification ratio - it would provide information about infrastructure's quality of the ABC gate system.

Success – defined as a finished process, without any human or system error. If traveller would not be allowed to cross border for some reasons, but they would finish process – it is considered as a "success".

Failure – defined as a process interrupted by some human or system error.

5.1.5 Identity verification

Table 5 Identity verification events

Trigger event	Impact event	Reason it failed	Recommendation
Positive identity verification	The process may proceed to the next event uninterrupted		
Negative identity verification	Negative result of biometric comparison	Biometric template not received	Repeat process of biometric data collection
The biometric data successfully captured	The process may proceed to the next event uninterrupted		
Failed to capture the biometric data	Failed to capture the face/iris/fingerprint	Biometric data not captured correctly – system failure	Face scanning camera may need maintenance to properly capture biometrics • Redirect travellers to other e-gate • Start the process again

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Trigger event	Impact event	Reason it failed	Recommendation
		Biometric data not captured correctly – traveller's mistake	A traveller may not stand in the right position: • Border guard assistance needed • Repeat action of collecting biometrics

For that sub-process the following could be monitored:

- **Success and failure ratio** higher failure ratio indicates gate low efficiency**:**
  - positive to negative identity verification ratio and negative to overall identity verification ratio – this would provide information about the general performance of the gate. For that purpose the number of "Failed to capture the biometric data" will be measured.
- **Mean time between unsuccessful identity verification**:
  - too many negative identity verification messages in e.g. 1 minute means that border guard assistance is needed
  - many negative identity verification messages will allow to establish certain threshold (e.g. number of negative identity verification messages per day)

Success – defined as a finished process, without any human or system error. If traveller would not be allowed to cross border for some reasons, but they would finish process – it is considered as a "success".

Failure – defined as a process interrupted by some human or system error.

5.1.6 Vehicle verification

Table 6 Vehicle verification events

Trigger event	Impact event	Reason it failed	Recommendation
The need of manual control	Vehicle plate not captured	SIS timeout	Maintenance and IT services are to ensure that the time-out message is certainly caused by outside systems by checking internal systems. A query should be sent to the SIS operator to inform them about the malfunction, as the cause possibly lies inside the external system, not the communication between systems

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Trigger event	Impact event	Reason it failed	Recommendation
		Traveller data found in SIS	If the data has been found in SIS, the received information from the system will consist among others the reason for the alert and why the person is in the SIS, what action law enforcement is to take in regard to that person, and whether said person has a history of violence and/or was armed. All those variables influence what techniques are to be used in the process
The need of manual control	Vehicle plate captured	SIS timeout	Maintenance and IT services are to ensure that the time-out message is certainly caused by outside systems by checking internal systems. A query should be sent to the SIS operator to inform them about the malfunction, as the cause possibly lies inside the external system, not the communication between systems
		Traveller data found in SIS	If the data has been found in SIS, the received information from the system will consist among others the reason for the alert and why the person is in the SIS, what action law enforcement is to take in regard to that person, and whether said person has a history of violence and/or was armed. All those variables influence what techniques are to be used in the process
	Number of passengers	SIS timeout	Maintenance and IT services are to ensure that the time-out message is certainly caused by outside systems by checking internal systems. A query should be sent to the SIS operator to inform him about the malfunction, as the cause possibly lies inside the external system, not the communication between systems
		Traveller data found in SIS	If the data has been found in SIS, the received information from the system will consist among others the reason for the alert and why the person is in the SIS, what action law enforcement is to take in regard to that person, and whether said person has a history of violence and/or was armed. All those variables influence what techniques are to be used in the process
No driver present in the vehicle	SIS check not possible	Waiting for traveller timeout	Process terminated

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Trigger event	Impact event	Reason it failed	Recommendation
A driver present in a vehicle	Data not found in SIS	RTP timeout	Maintenance and IT services are to ensure that the time-out message is certainly caused by outside systems by checking internal systems. A query should be sent to the RTP operator to inform them about the malfunction, as the cause possibly lies inside the external system, not the communication between systems
		Vehicle and traveller data not found in RTP	Process terminated, vehicle/traveller not eligible to cross the border

For that sub-process the following could be monitored:

- **Success- failure ratio** - higher failure ratio indicate low gate efficiency:
  - positive to negative vehicle verification ratio and negative to overall vehicle verification ratio - this would provide information about numbers of the persons which successfully crossed the border using ABC gates for vehicles.
- **Mean time between unsuccessful identity verification** – it would provide information about possible unfavourable weather conditions or a system error:
  - too many negative identity verification messages in short period of time means that border guard assistance is needed
  - many negative identity verification messages will allow to establish some threshold
- **Correlation between:**
  - weather and error ratio.

Success – defined as a finished process, without any human or system error. If traveller would not be allowed to cross border for some reason, but he/she would finish process – it is considered as a "success".

Failure – defined as a process interrupted by some human or system error.

5.2 Gate surveillance

The procedures of the "Gate Surveillance" process are split into two separate sub-processes that are in different cases either independent, or dependent on each other. Figure 6 presents interdependencies between sub-processes.

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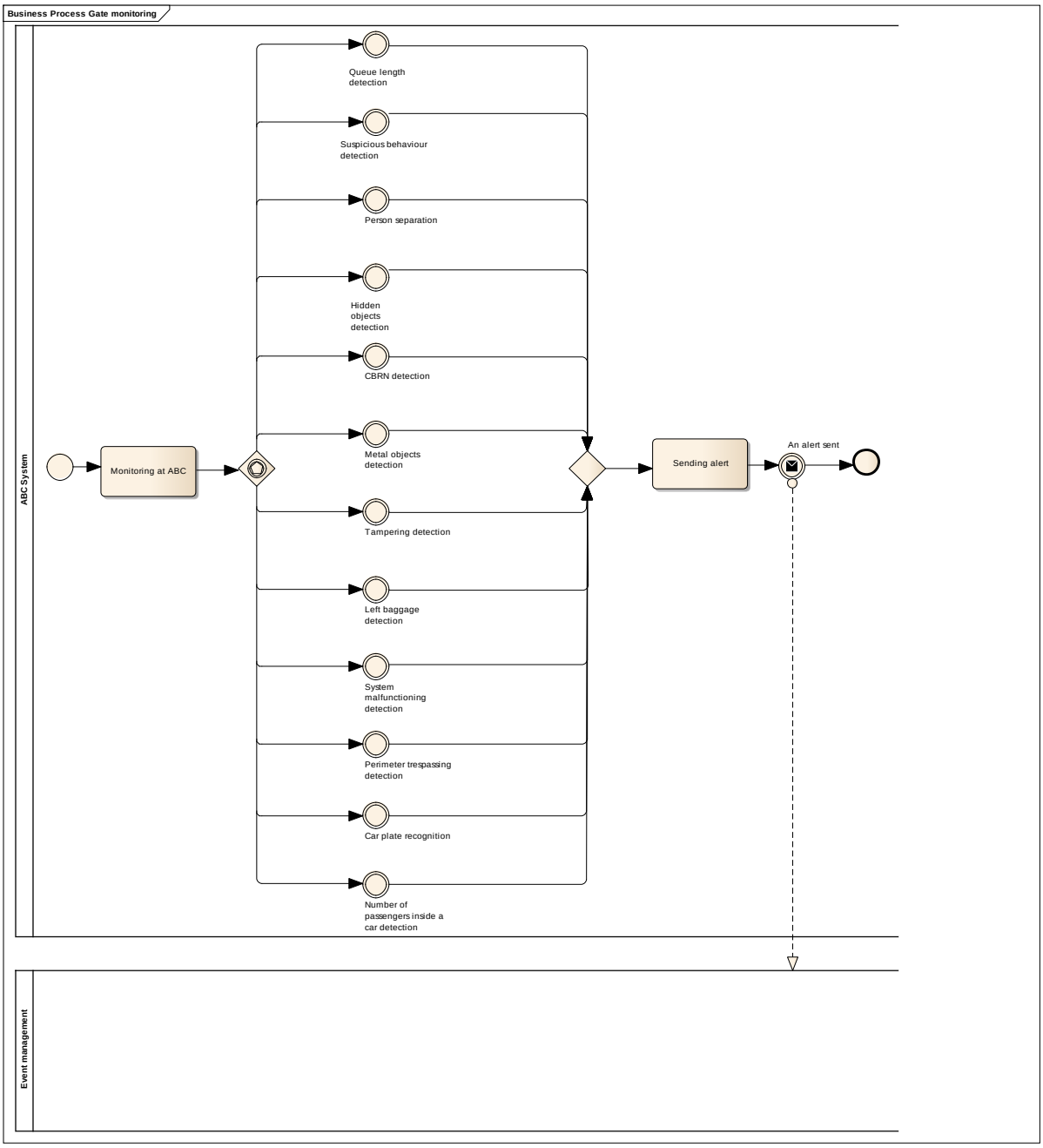

Figure 6 Gate Surveillance diagram [source: D8.1]

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Table 7 Gate surveillance process outline

Event	Sub-process	Chapter contains detailed information	Monitoring techniques

Gate surveillance	Gate surveillance "at and around" the gate	Chapter 5.2.2	• Move detecting cameras
			• Sensors
			• Scanners
			• Statistics:
			  ○ Detecting the potentially dangerous situations
			  ○ True / false incidents ratio

	Flow optimization	Chapter 5.2.3	• Move detecting cameras
			• Statistics:
			  ○ Determining border-cross load
			  ○ Detecting the potentially dangerous situations (statistic)
			  ○ Correlations (statistic)
			  ○ True / false incidents ratio

Gate surveillance is going to use some measurements collected on process described in chapter 5.1, but in contrast to border check process – gate surveillance will be based not only on statistical tools, but also on some high-technology solutions, like move-detection cameras or sensors.

5.2.1 Monitoring techniques for gate surveillance

The available technology was described in D5.1, thus this chapter will not provide detail definitions of them, but will just mention some of these solutions and provide ideas about using them. Thanks to this analysis, machine learning algorithms and predictive statistic, gate surveillance process might be monitored for effectiveness and – what is the priority of this process – safety and security.

The bullet points in the tables above are the monitoring techniques for gate surveillance (most of all – measuring effectiveness, safety and providing information for flow optimization). After some period of time for testing and setting the standards it would be possible, based on these standards, to provide some fringe (critical) values (e.g. for number of people per hour or time or mean time between some events), above which border guards should somehow react (e.g. by opening more ABC gates or directing more human resources). In the understanding of this document, adaptive selection is the selection of appropriate resource with regard to a given situation. The criteria should be also applicable to technical solutions – e.g. if in some border-crossing there is a

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problem with efficacy of technical solutions in detecting of some kind of dangers, then border guards should consider providing adequate actions to increase this ratio (e.g. by making some changes within infrastructure of border cross or ABC gate system).

- **Determining border-cross load:**
  - Number of people per hour/day/month,
  - Number of people per gate,
  - Number of people per season,
  - Number of EU travellers/TCN,
  - Analysis of travellers' distribution between gates.

Similarly, as in in the previous chapter, these kinds of statistics provide information about general and real-time situation on cross-border. Therefore – they provide a whole picture of the situation, measuring load and enable recognition of problematic areas or periods of time.

- **Detecting the potentially dangerous situations:**
  - Number of dangerous situation (alarms) detected by cameras,
  - Number of dangerous situation (alarms) detected by CBRN sensors,
  - Number of dangerous situation (alarms) detected by scanners,
  - Number of dangerous situation (alarms) detected by observation through monitoring system,
  - Number of perimeter trespassing events,
  - Number of suspicious behaviour detection events,
  - Number of dangerous situation (alarms) detected by border guards,
  - Overall frequency of alarms.

Providing these monitoring techniques is the condition for generating the rest of the analyses – these data are the main input for most of them. These tools allow to detect potentially dangerous situations in real-time and provide possibility to immediately react to them. They would also be useful to determine the border crossing with the higher ratio of alarms and make some analysis to interpret that. It could mean, e.g. that this particular border crossing is really effective in detecting dangerous situations (and that is why they obtained higher frequency of alarms) or there are, for some reason, more potentially dangerous situations. It could also mean that among number of people is crossing this border and that is why frequency is higher. To verify that, and to prevent mistakes in interpreting – it is important to set all of the data together (in this case – especially true/false incidents ratio).

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- **True / false incidents ratio**
  - number of alarms to number of travellers using ABC gates,
  - Number of true alarms to overall number of alarms,
  - Number of true alarms to number of false alarms,
  - Number of true suspicious situation detected by technical tools to number of true suspicious situation not detected by technical tools, but by border guards.

However, these statistics will validate correctness work of the ABC gate system and furnish information about eventual faults. It also allows to monitor the efficacy and reliability of the technical solutions. After some periods of time it would be possible to check which kind of suspicious behaviour or detecting which kind of dangerous materials is problematic for technical tools (by analysing what system could not, but border guard could "catch"). After some analysis, it can be expected that there will be some improvements to make ABC system more effective and therefore safe and secure.

- **Correlations:**
  - Between queue length and day of week/season,
  - Between type of border and most frequent potentially dangerous events,
  - Between type of the perimeter trespassing incidents (low risk, medium risk, high risk) and false alarms ratio,
  - Between types of the perimeter trespassing incidents (low risk, medium risk, high risk) and technical tools (cameras, sensors, etc.) effectiveness in detecting them.

Correlations, most of all, give some proposals of the solutions worth testing in flow optimization field. They are providing information about problematic areas or periods of time – where or when it would be suggested to enter additional resources (human – like more border guards or technical – like e.g. more opened ABC gates during some periods of time, or more motion detection cameras).

5.2.2 Gate surveillance "at and around" the gate

Constant surveillance of the gate itself and its surroundings is a necessary element of the security of the border check process. Every threat to the processes security must be quickly detected, identified and reacted to in an appropriate manner and in accordance to the specific procedures related to the subject of the alert. Those threats may include things like hidden and hazardous objects, unclaimed pieces of luggage in the gate area or potential trespassers. In the following table the threatening factors have been outlined and adequate monitoring techniques were presented to keep up with the

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development of threatening situations from a specific type of sub-process. Finally, basic recommendations were provided.

Table 8 Gate surveillance sub-process

Sub-process	Description	Monitoring technique	Recommendation

CBRN detection	Detecting hazardous chemical, biological, radiological and nuclear material	• CBRN sensors
		• Statistic:
		  ○ Ratio of fake alarms to real ones
		  ○ Frequency of alarms
			When a threatening material is detected, internal procedures regarding CBRN threats must be applied

Metal objects detection	Detecting various potentially dangerous or illegal objects made from metals	• Metal detectors (handheld/portable, pass-through)
		• Full body scanners
		• Monitoring observation
		• Statistic:
		  ○ Ratio of fake alarms to real ones
		  ○ Frequency of alarms
			A metal detection alert requires a manual check of said possible objects and a thorough individual check

Hidden objects detection	Detecting items that are for some reason hidden from the security check. Those might include illegal substances and goods	• Pat-downs
		• Full body scanners
		• Monitoring observation
		• Statistic:
		  ○ Ratio of fake alarms to real ones
		  ○ Frequency of alarms
			If there is a reasonable suspicion based on monitoring techniques, that the traveller might have tried to hide an object, a manual check is to be performed

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Sub-process	Description	Monitoring technique	Recommendation

Tampering detection	Detecting if any unauthorized persons are attempting to manipulate the border control processes, devices and infrastructure involved	• Monitoring observation
		• Statistic:
		  ○ Ratio of fake alarms to real ones
		  ○ Frequency of alarms
			If observation of area or processes performance reveals some possible outside interferences, a thorough security check of the facility is to be performed to ensure that no further breaches have been made. Perpetrators are to be subject to local law in regards to their actions

Left luggage detection	Detecting any left, lost and unsupervised pieces of luggage	• Monitoring observation • Statistic: ○ Frequency of traveller lost luggage notifications	Any place with plenty of travellers, especially tourists, will have to establish protocols for dealing with unclaimed, both temporarily, and permanently, luggage. As the luggage may contain hazardous materials that could threaten the security of the facilities, it has to be carefully handled, inspected, stored and finally sold or destroyed
System malfunctioning detection	Detecting situations of abnormally abridged system efficiency due to hardware or software errors	• Monitoring observation • System health checks • System performance analysis	A systemic malfunction has to be removed as quick as possible
Person separation	Ensuring that only one person at a time enters a specific area (e.g. gate)	• Monitoring observation	To make sure that the processes are uninterrupted only one person may be present during some phases of the border control process

5.2.3 Flow optimization

This part of the border check process regards managing the movement of the travellers during the process. For the process to run flawlessly, passengers need to pass the particular checkpoints in a fast, orderly way in accordance to guidelines. To ensure that this is the case, they need to be constantly monitored, counted, their flows are to be interpreted in search of some common tendencies that might lead to bottlenecks now or in the future. Adaptive responses have to be implemented to counteract the natural flock

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behaviours of the passengers and some disorder must be accepted as a natural state of affairs, as travellers cannot be drilled to follow every instruction to the letter every time.

Table 9 Flow optimization sub-process

Sub-process name	Description	Monitoring techniques	Recommendation
People counting	People counting is about checking if the ABC gates are not overloaded and if number of border guards is adequate. It is performed for safety and quick service of the ABC gates	• Number of people per hour/day/month • Number of people per gate • Number of people per season (statistical data) • Number of regular travellers/TCN • Traveller detection and tracking	Number of individuals currently in the vicinity of the gate or in other key sectors of the gate has to be constantly monitored, both for safety and efficiency purposes. Crowded gates may need to have a release valve – opening an unused gate or increasing personnel involvement to quicken the process
Queue length detection	Queue length detection is about determining the number of travellers waiting for service. Evaluating is key for quick service	• Correlation between queue length and day of week/season • In real-time: travellers distribution between gates • Traveller detection and tracking	Crowded gates may need to have a release valve – opening an unused one or increasing personnel involvement to quicken the process
Perimeter trespassing detection	Perimeter trespassing detection is about warning the border guards about unauthorized person detected in banned area	• Type of incidents (serious, medium risk, low risk) • False alarm (predefined threshold) • Number of perimeter trespassing events	Potentially dangerous breaches of both inside and perimeter security must be immediately detected and stopped. If incidents reoccurs, additional means should be dispatched to protect the perimeter or provide deterrence

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Sub-process name	Description	Monitoring techniques	Recommendation
Suspicious behaviour detection	Suspicious behaviour detection is about preventing dangerous situations and illegal border-crossing	• Movement tracking algorithms • Number of suspicious behaviour detection events	It is very difficult to track down suspicious behaviour and to be exactly sure whether it is a threat to the facility safety, as different people have different behavioural patterns which do not necessarily mean that they pose a danger if they do not behave in accordance with some predefined algorithms. Therefore, human involvement is very often necessary to interpret complex, individual situations and to react to potential nuisances

5.3 Traveller assistance

The most important actor in the process is the passenger himself. It is his comfort, safety, well-being, and his success in crossing the border check that is the goal of all of the actions partaken by border guard during the whole process. Therefore it is absolutely key to establish a culture of "customer first" approach, where the whole crew and even the procedures are user-friendly. Travellers should not be treated as just units and numbers crossing the border but as partners – their goals are after all exactly the same as those of border guards. Particular ways of ensuring that those goals are fulfilled are for example watching for suspicious behaviour of some passengers – sometimes what looks like suspicious acts may be just signs of being lost and feeling of distress and passenger may need to be tended to. Flexibility is advised in dealing with those matters, as problems sometimes arise due to atypical circumstances which may not fit any of the codified procedures.

One cannot overstate the importance of being helpful to the passengers. If they feel like they are involved, and that they are well taken care of, and that they and the border guard officers are working towards a common goal, the process is going to proceed in a more orderly, efficient way.

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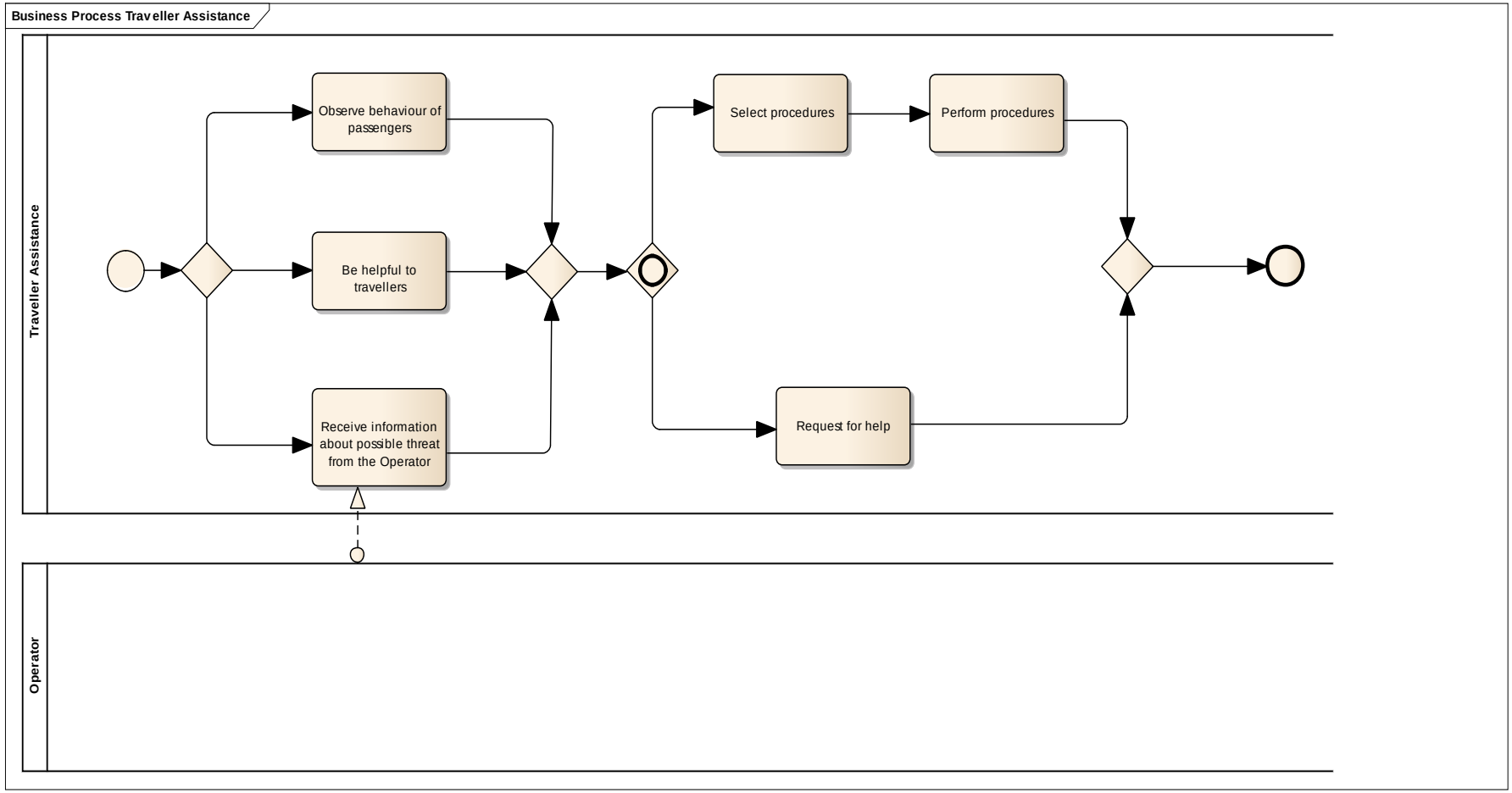

Figure 7 Traveller assistance diagram [source: D8.1]

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Traveller Assistance personnel, protocols and procedures focus on the wellbeing, comfort and safety of the travellers. Key precautionary actions identified in the Traveller Assistance process were identified as “Observe behaviour of passengers”, “Be helpful to passengers” and “Receive information about possible threat from the operator” and finally, the actions they perform after a crisis finally occurred - “Problem Solving”.

Table 10 Traveller assistance process outline

Actions name	Chapter contains detailed information	Monitoring techniques
Observe behaviour of passengers	Chapter 5.3.2	• Detecting and counting atypical situations
Be helpful to travellers	Chapter 5.3.3	• Detecting and counting atypical situations • True / false incidents ratio • Mean • Determining people with disabilities interest of ABC gates
Receive information about possible threat from the Operator	Chapter 5.3.4	• Detecting and counting atypical situations
Problem solving	Chapter 5.3.5	• Detecting and counting atypical situations

5.3.1 Monitoring techniques for traveller assistance

The process of travelling may be long, tiresome, stressful and complicated. Even with the best intentions in the minds of creators of the systems involved, the border crossing process may be viewed by some passengers, especially those that are not used to it, as unnecessarily difficult and rigorous. The constantly growing role of high end technology in the process is a drag on the comfort level of some passengers, mostly elderly. Even very young travellers have their own special needs and special circumstances must happen for them to feel at ease, which allows for a smoother process. As not every single need of a particular group can be sewn into the fabric of the system and the processes themselves, some flexible parts of the system must be present to allow for personalized response to occurring problems. This role is realized through establishing Traveller Assistance teams – personnel specialized in constantly supporting and facilitating the processes that the travellers go through by individual aid.

- **Detecting and counting atypical situations**
    - Number of atypical situations that standard procedures could not apply to.

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- Scope of atypical situations that standard procedures could not apply to.
- Number and percentage of situations when traveller assistance requested for help.
- Number of suspicious behaviour detection events.
- Number of complaints for assistance's help to number of travellers using ABC gates.
- Total number of problems.
- Number of problems during some period of time (hour, day, week, etc.).
- Ratio of problems referred to the operator to problems solved by the Assistants without referral.

These category of monitoring techniques will be useful for improving the ABC system infrastructure. If the number of atypical situations without predefined procedures would be high – that would be a sign that more attention should be given to management procedures. However – high ratio of atypical situation would not be necessary a symptom of the unfitted procedures. It can be also an evidence of the non-intuitive solutions of ABC gates.

- **True/ false incidents ratio**
  - Number and percentage of sustained complaints for assistant's help,
  - Number of unsuccessful helps to number of overall helps.

Proportion of the true to false incidents is necessary for verifying the quality of the traveller assistance. It is going to provide information about eventually field for growth for traveller assistants and necessary training. It will be also useful to gather traveller unfulfilled expectations to analyse what is important for them and to improving the ABC system.

- **Mean**
  - Average time of assistant's help duration after an error.

This mean would provide information about response time of the traveller assistant and would show, which of them cope better with different kind of situation. It would also give some information about the most time-consuming type of problems and allows to take action, which would make this process faster in the future.

- **Determining people with disabilities interest of ABC gates**
  - Number and percentage of people with disabilities using ABC gates.

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5.3.2 Observe behaviour of passengers

One of the most effective (however, not especially cost-effective) methods of monitoring and ensuring security and uninterrupted progress of border check processes and security control in general is putting heavy human resources on it. People have uncanny intuitions on what is happening and can interpret atypical signals and behaviours that even the best algorithms may miss. With constant observation of the passengers groups human Traveller Assistants can identify problems using their experience and solve them more flexibly. Passenger behaviour can show many different key information. Are they distressed? Are they uneasy? Or are they relaxed and do accept the process procedures? Those are important factors in determining how well the process works, as the traveller is the subject of said process. His/her opinion must be valued strongly. Traveller Assistance crews serve as a counterweight to the growing "technologization"(more high tech solutions used) of the process, to which some internalized opposition may be present.

Table 11 Passenger behavior actions

Actions name	Description	Monitoring techniques	Recommendation
Observe behaviour of passengers	There are at least three reasons to observe behaviour of travellers. First – to detect suspicious behaviours, second – to verify ABC system usability and third - to improve algorithms of movement tracking, mostly for safety reasons	• Movement tracking algorithms • Number of suspicious behaviour detection events	Passenger behaviour patterns are a valuable measuring tool that can tell a lot about the systems design. The patterns should be analysed in long and short periods of time to ensure that adequate capacity is available to deal with traveller flows

5.3.3 Be helpful to travellers

A self-explanatory action in the process, involves human assistants to be proactive in assisting the travellers with any urgent travel- and border crossing related issues they might have. Their presence must be visible and numerous enough to make sure that passengers feel as they are "taken care of" by the personnel. Assistants are encouraged to patrol the gate areas, watch out for potential problems, and possibly try to predetermine which particular groups may be at high risk of failing some parts of the processes, like a group of elderly or disabled. Those may warrant a thorough walkthrough of the process.

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Table 12 Be helpful to passengers actions

Actions name	Description	Monitoring techniques	Recommendation
Be helpful to travellers	Some travellers might be confused with ABC gate system, so it is necessary to help some of them	• Number of complaints for assistant's help/ number of travellers using ABC gates • Number and percent of sustained complaints for assistant's help • Average time of assistant's help duration after an error • Number of unsuccessful helps / number of overall helps • Number and percentage of people with disabilities using ABC gates	Making passengers comfortable and safe is an important issue. Helpful staff should be always available on site to provide assistance at all times in every situation. The number of the staff should be adjusted to typical number of passengers using past data from similar periods

5.3.4 Receive information about possible threat from the Operator

The Assistants must be constantly up to date in regard to the current situation on the border crossing and have to know if there are some potential security issues brewing, like an increased traffic, suspicious behaviour by some passenger or a group of them, and they have to be able to respond to those threats in some fashion.

Table 13 Receive information from the Operator actions

Actions name	Description	Monitoring techniques	Recommendation
Receive information about possible threat from the Operator	Border guard should be in touch with the Operator to be able to detect any problems	• Number and percentage of traveller assistants requests for help • Number and scope of atypical situations that standard procedures could not apply to	It is absolutely necessary for the on-the-ground officers to be in constant touch with the operators/headquarters. Establishing primary and secondary links is advised in case the main communication channel (e.g. Short-wave radio) fails

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5.3.5 Problem solving

Has a problem occurred after the precautionary measures have been taken anyway, Travellers Assistants are often the first responders to a growing security issue. Their choice is basically limited to two official options and one that is outside the procedures. Official problem solving is either choosing an applicable procedure and fulfilling its recommendations, or requesting help. The unofficial option is helping passengers in very atypical situations that are not described in the procedures at all, yet are trivial enough not to warrant requesting reinforcements or even leaving the post. The Traveller Assistant may consult operators in regard to which procedures are to be applied and to what should be the scope of his intervention.

Table 14 Problem solving actions

During-crises action name	Description	Monitoring techniques	Recommendation
Problem solving	Problem solving providing information about the quality of the ABC system (low problem ratio means that system was well designed)	• Total number of problems/problems per traveller served/problems per day • Problems referred to the operator/problems solved by the Assistants without referral • Number and scope of atypical situations that standard procedures could not apply to • Number of complaints about problem solving total/per problem	Nature of the problem must be investigated. It has to be determined if the nature of the problem has the roots in the system or the procedures, in which case they should be reviewed in case of high number of occurrences. Some problems will inevitably arise that are outside of accepted procedures and they will have to be dealt with one by one basis. Flexibility is therefore advised

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5.4 Quality assurance

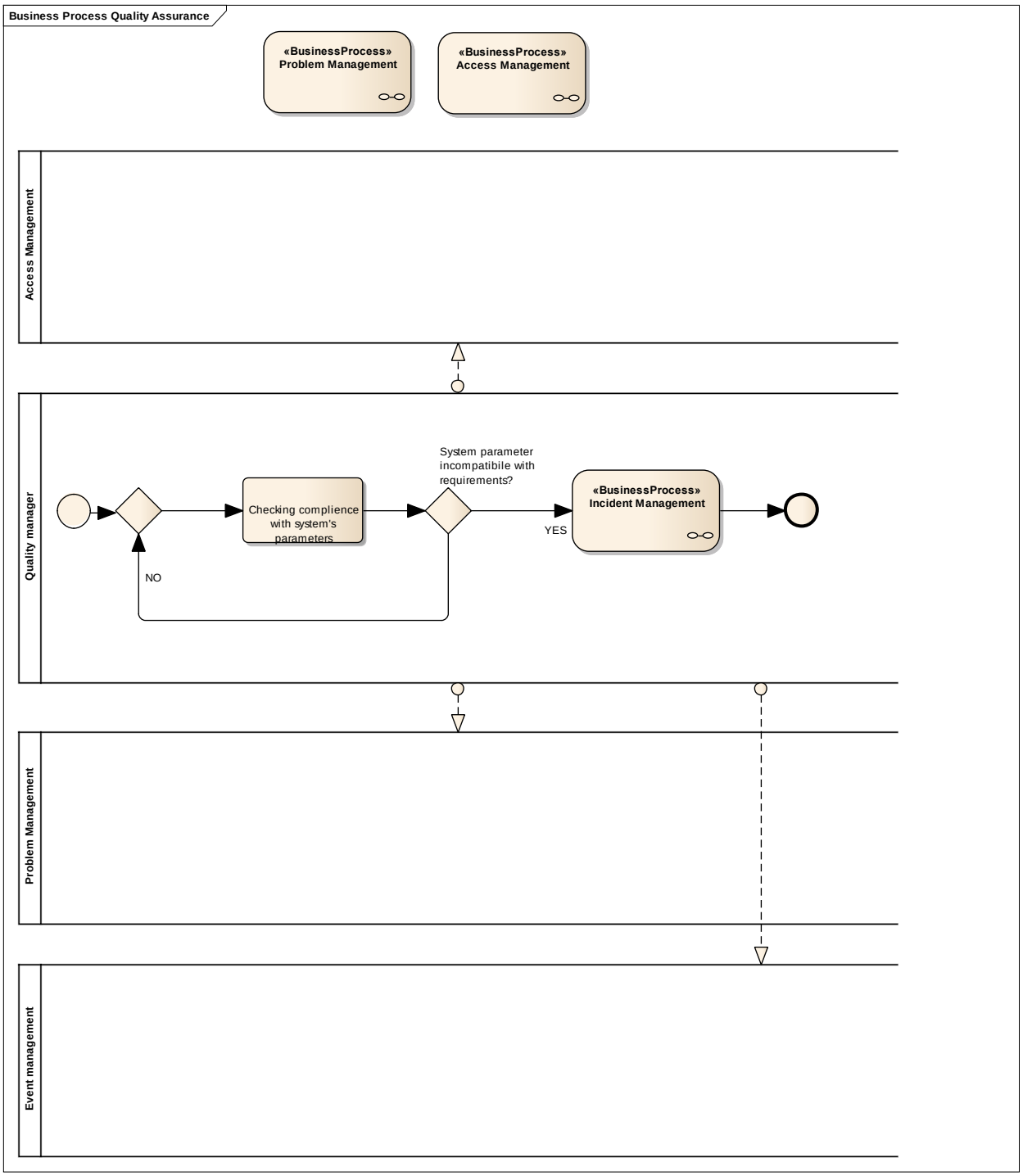

Figure 8 Quality assurance diagram [source: D8.1]

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Table 15 Quality assurance process outline

Quality Assurance	Chapter contains detailed information	Monitoring techniques
Access Management	Chapter 5.4.2	• Quantitative data • Qualitative data
Event Management	Chapter 0	• Quantitative data • Qualitative data
Incident Management	Chapter 5.4.4	• Quantitative data • Qualitative data
Problem Management	Chapter 5.4.5	• Quantitative data • Qualitative data

5.4.1 Monitoring techniques for quality assurance

The main goal of quality assurance process is supervisor of all harmonized processes as a whole by collected general statistics about abnormal gate behaviour events from other processes.

- **Quantitative data:**
  - Times accessed per staff position and per separate staffer.
  - Time accessed per hour.
  - Times access attempted by an unauthorized persons.
  - Times security breached.
  - False rejection ratio (authorized personnel rejected).
  - Number of events.
  - Number of incidents.
  - Number of situation for which procedures were not prepared.
  - Overall number of errors.
  - Number of errors during different type of harmonized processes.
  - Number of system errors during different type of harmonized processes.
  - Number of human errors during different type of harmonized processes.

These data will provide information about general situation on all processes and will be helpful in detecting the weakest elements of ABC system infrastructure. More detailed information about reasons why some parts of the system are not working properly will

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be provided from analyses on particular processes (during border check, gate surveillance, traveller assistance, quality assurance). Description of the kind of analyses prepared on these sub-processes can be found in the previous chapters.

Information gathered on this stage of analyse are also going to help during quality assurance – due to them it will be possible to direct a problem to proper management department (access management, event management, incident management, problem management).

- **Qualitative data:**
  - Typology of the errors during different stages of the management.
  - Typology of the situations without predefined procedures.

Typology of the abnormal courses of the processes will be prepared basing on the quantitative data. Thanks to them, the service quality on border check will be improved and border guards will be better prepared for different kinds of unusual situations.

5.4.2 Access Management

Table 16 Access management

Quality Assurance	Description	Monitoring techniques	Recommendation
Access Management	Providing authorized personnel with adequate level of clearances to access specific facilities and services for staff	• Statistic: ○ Times accessed ○ Times accessed per staff position, per separate staffer, per hour ○ Times access attempted by an unauthorized persons ○ Times security breached ○ False rejection ratio (authorized personnel rejected)	Access to vulnerable sections of the facility must be strictly restricted. Levels of clearances must be established, possibly even every post could have its own set of clearances. Access data must be carefully dissected to ensure safety

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5.4.3 Event Management

Table 17 Event management

Quality Assurance	Description	Monitoring techniques	Recommendation
Event Management	Every event must be logged for analytics reasons	• Statistic: ○ Overall number of events	Overall oversight of the events is a standard management procedure and has to be routinely performed

5.4.4 Incident Management

Table 18 Incident management

Quality Assurance	Description	Monitoring techniques	Recommendation

Incident Management	The goal of Incident Management process is handling the exceptions that occur in ABC system, which disrupts, or which could disrupt, a service	• Statistic:
		  ○ Number of incidents
		  ○ Number of situation for which procedures were not prepared
		  ○ Frequency of situation for which procedures were not prepared
		  ○ Defining the typology of the situations without predefined procedures
			On the basis of gathered data one should establish an accepted incident threshold, over which emergency reviews and protocols should be performed and put in place. Some incidents, also unresolved ones, are always bound to happen and the role of the management is to limit their occurrences

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5.4.5 Problem management

Table 19 Problem management

Quality Assurance	Description	Monitoring techniques	Recommendation
Problem Management	Problem management is about minimising the adverse impact of incidents and problems on the border check process that are caused by underlying errors within IT infrastructure or problems unrelated with IT infrastructure	• Statistic: ○ Overall number of errors ○ Number of errors during Border Check Process ○ Number of errors during Gate Surveillance process ○ Number of errors during Traveller assistance ○ Number of system errors in different types of processes ○ Number of human errors in different types of processes	On the basis of gathered data one should establish an accepted problem threshold, over which emergency reviews and protocols should be performed and put in place. Some problems, also unresolved ones, are always bound to happen and the role of the management is to limit their occurrences

6 Conclusions

The presented deliverable has accomplished the set objectives in regard to monitoring techniques used within the harmonized processes and the adaptive selection of and inside those techniques. BPMN notation has been adopted as a tool designed to visualize the described processes. Attached graphs represent the flows of sequences inside the processes and show the interdependence of different events and activities. Through the length of the document, it has been shown that rationalizing and optimizing some processes is possible thanks to using specific adaptive monitoring techniques, enhancing the knowledge about the processes in real time and in the long term. Adaptability for monitoring systems has been highlighted as a key aspect in safety and efficacy of overall border control process. The potential improvements that this document covered include border check, gate surveillance, traveler assistance and quality assurance and their subsequent processes. Those results were achieved through a four step initial process, broken down further afterwards. First, the system environment was defined using a broad, holistic approach. Following that, all of the events of importance inside given processes were identified and analyzed for their relative importance in the process using a more detailed approach. For the key events monitoring techniques with adequate capabilities have been chosen and lastly,

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guidelines regarding chosen monitoring techniques and their outcomes have been presented. Monitoring techniques were both general (ratio of successful and failed sub-processes, mean time between events and various correlations) and process-specific(see tables). These steps gave a good outlook on both the global and detailed perspectives of the process and consequent choice of monitoring tools and the addition of specific guidelines give a concrete tool to use in further work.

To sum up, a comprehensive breakdown of the border control processes has been presented. This deliverable will be used as input for further actions.

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7 Appendix

7.1 List of figures

7.2 List of tables

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