

Deliverable 2.3 Report on KQIs

Coordinator Name: Christos Panayiotou

Coordinator Email: christosp@ucy.ac.cy

Project Name: Real-time Artificial Intelligence for DEcision support via RPAS data analyticS

Acronym: AIDERS

Grant Agreement: 873240

Project Website: <u>http://www.kios.ucy.ac.cy/aiders/</u>

Version: 1.0

Submission Date: 31/5/2020

Dissemination Level: Public













Contents

Ex	ecutive S	Summary	1
1	Introdu	uction	2
2	Key Qu	ality Indicators	2
3	Metho	dological approach	3
4	Key Qu	ality Indicators in AIDERS	5
	4.1 Rel	liability	5
	4.1.1	False measure/data transmission/data treatment rate (per cent rate)	5
	4.1.2	Latency/Response Time (moderate, medium, high)	5
	4.1.3	Number of Failures (per cent rate)	5
	4.2 Ro	bustness	6
	4.2.1	Time to restart after a failure (Minutes)	6
	4.2.2	Percentage of events causing a failure (per cent rate)	6
	4.2.3	Probability of data loss or corruption on failure (per cent rate)	6
	4.3 Usa	ability	6
	4.3.1	Easy platform to use (moderate, medium, high)	6
	4.3.2	Intuitive (moderate, medium, high)	6
	4.3.3	Comprehensive interface (moderate, medium, high)	6
	4.3.4	Satisfaction level (moderate, medium, high)	7
	4.4 Caj	pacity & Resource Planning	7
	4.4.1	System users (Number)	7
	4.4.2	Resource allocation (moderate, medium, high)	7
	4.4.3	Tactical or operational situation (moderate, medium, high)	7
	4.5 Au	tonomy	7
	4.5.1	Automatic detection or estimation (per cent rate)	7
	4.5.2	Automatic decision-support (per cent rate)	7
	4.6 Int	eroperability	8
	4.6.1	Integration with legacy systems (moderate, medium, high)	8
	4.6.2	Integration with different type of UAVs (moderate, medium, high)	8

	4.6.3	Integration with different type of sensors (moderate, medium, high)	8			
	4.7 Effi	ciency	8			
	4.7.1	Time to detect (Minutes)	8			
	4.7.2	Reaction Time (percent)	8			
	4.7.3	Accuracy (moderate, medium, high)	8			
	4.7.4	System Performance	9			
	4.8 Human Cost9					
	4.8.1	Protect FR (moderate, medium, high)	9			
	4.8.2	Human casualties (Number)	9			
•	4.9 Cos	st Effectiveness	9			
	4.9.1	Operational costs (Euro)	9			
	4.9.2	Return on Investment (Euro)	9			
5	Tracea	bility Matrix1	0			
6 0	5 Conclusions16					

Executive Summary

This deliverable is focused on identifying and defining the Key Quality Indicators (KQIs). For defining the indicators, we consider a) the threat and hazards analyzed in the aspects of selection and use of RPAS, which have been extensively analyzed and presented in Deliverable 2.2 "Report on threats and hazards"; b) the usage of UAVs in emergency response missions and in particular the outcomes of Deliverable D2.1 "End User Requirements"; and c) the usage of technology systems in emergency response based on a systematic literature review (SLR). The methodology followed for defining the KQIs is thoroughly documented and enables the easy adaption to other scenarios when deemed necessary. Finally, the Traceability Matrix which will be used to check, trace, evaluate the KQIs during evaluations of the AIDERS toolkit in exercise scenario's and tastings is defined and included in this deliverable.

1 Introduction

As extensively discussed in Deliverable 2.2 "Report on threats and hazards", threats and hazards affect significantly every country and their impact can be minimized only after strategically defining and introducing emergency response mechanisms. The EU-funded project DG ECHO AIDERS aims to introduce technological solutions that can support first responders in addressing threat and hazard events, operate more optimally and make better decisions during emergency situations.

The definition and usage of key quality indicators, either in simulation or in real time crisis management, will enable decision makers to assess the consequences of incidents and crisis scenarios, to compare possible impacts resulting from alternative actions, to support strategic decisions on capabilities and related investments, to optimize the deployment of the RPAS dedicated to evacuation, and to improve action plans for preparedness and response phases.

2 Key Quality Indicators

Key Performance or Key Quality Indicators (KQIs) can be used to validate system requirements and/or to evaluate its efficiency, as well as the concept of operations that it serves, such as emergency response. The choice of the KQIs is highly context-specific, but all KQIs share the following common characteristics:

- KQIs measure either the absolute result or the efficiency of the emergency management.
- They are valid in the scope of the whole scenario either cumulative or pertinent.
- They really matter to the stakeholders, i.e. a certain KQI is only relevant for some specific decisions by some specific stakeholders.

Non-systematic approaches to developing quality indicators do not tap into the evidence base of an aspect based on the availability of data and real-life critical incidents. *Systematic* approaches are based directly upon scientific evidence such as rigorously conducted (trial based) empirical studies.

3 Methodological approach

The method that AIDERS consortium followed to identify KQIs was an adapted systematic approach divided in three distinct steps; namely i) systematic literature review (SLR), ii) insights derived from D2.1, D2.2, iii) KQI final selection.

A systematic literature review was carried out identifying, collecting and evaluating all available research to the topic area "Key Quality Indicators for emergency response management". The search strategy that was followed was blended, focusing on two pillars; on the one hand academic literature (relevant books, book chapters, journals, etc.) and empirical data collected mainly by previous (similar) EU funded projects seeking for lessons learnt and similar KQIs, as well as on the open internet search. On the other hand, search words and strings ensured some useful insights from the internet. Several Boolean Search strings were devised combining terms such as "Emergency response" AND/OR "Quality Indicator" AND/OR "Disaster Response" AND/OR "System Performance Indicator" AND/OR "KQI" and so on so forth. The SLR resulted a total number of 40 distinct KQIs.

The second and crucial step was the thorough review of AIDERS Deliverables D2.1 "End User Requirements" and D2.2 "Report on threats & hazards". The analysis made on both deliverables leaded the consortium to identify exclusion criteria so as to conduct the sorting of Key Quality Indicators. In the context of the project, the identified End user needs and requirements together with the analysis conducted for threats and hazards were considered as the main exclusion criteria and drove the consortium to focus only on the KQIs of interest.

The final step included the screening of KQIs, taking into consideration the exclusion criteria. Any KQI identified throughout the first step (SLR) which was not relevant or not of interest of the end users (step 2) was eventually suppressed. The collection of KQIs was also classified in 9 categories according to their relevance, namely Reliability, Robustness, Usability, Capacity & Resource Planning, Autonomy, Interoperability, Efficiency, Human Cost and Cost Effectiveness. The total number of KQIs that were finally documented for AIDERS project were 28.

The scheme below depicts the methodological approach, which can be used and easily adapted for different scenarios in the framework of AIDERS project, as well as for similar activities.



Figure 1: KQI definition - Methodological approach

For the documentation and tracking of KQIs a Traceability Matrix, including KQI ID number, short description, metric, evaluation date and score, was used that will be presented in section 5. Although and as the Traceability Matrix is part of the methodological approach, it is worth mentioning that test strategy was not mentioned as it exceeds deliverable's scope; however, the generic strategy that AIDERS consortium will follow is to test the system, measuring the relevant KQIs in 2 distinct ways:

• Laboratory testing, to which only technical partners will participate. Laboratory trial includes the testing of specific components for the verification/validation of AIDERS system

 On-field testing/Simulated exercises, to which all consortium partners will take part, according to their availability. On-field testing includes the simulation of emergency response scenario(s) with the support of AIDERS system, giving the opportunity to the consortium to test system's capabilities in a protected environment (or even real incidents) so as to validate/evaluate the platform.

4 Key Quality Indicators in AIDERS

Following the aforementioned methodology and as far as it concerns the underdevelopment AIDERS platform, consortium came up with the below Key Quality Indicators that are classified in 9 different categories.

4.1 Reliability

This section refers to the capability of the system to function in a correct manner within the given timeframe. This includes high accuracy of alert localization, avoidance of any delays in data provision, and a low rate of false alerts or errors.

4.1.1 False measure/data transmission/data treatment rate (per cent rate)

This KQI identifies how many times (percent) the system generates false alarms – False Positive Rate (FPR). This KQI is applicable to some of the estimation, prediction and detection algorithms that will be incorporated in the platform such the false alarm rate for measuring the accurate detection of people.

4.1.2 Latency/Response Time (moderate, medium, high)

This KQI measures in milliseconds the time interval between the stimulation/cause and response/effect of AIDERS platform.

4.1.3 Number of Failures (per cent rate)

This KQI identifies how many times (percent) the system was able to be used without restarting or retrying.

4.2 Robustness

This section measures or extents the ability of the AIDERS system to continue to function despite the existence of faults in its component subsystems or parts and to resist change without adapting its initial stable configuration.

4.2.1 Time to restart after a failure (Minutes)

This KQIs measures the time – differences in minutes that the system takes to restart after a failure.

4.2.2 Percentage of events causing a failure (per cent rate)

This specific KQI will identify the rate in percentage of the events that will cause a failure in the system.

4.2.3 Probability of data loss or corruption on failure (per cent rate)

This KQI mill measure the rate of the data that will be lost or will corrupt on failure.

4.3 Usability

It is regarded as a set of attributes covering the effort needed for using a solution, and on the individual assessment of the use of the solution, by a stated or implied set of users.

4.3.1 Easy platform to use (moderate, medium, high)

This KQI measures the overall user-friendliness in terms of ease of deployment/setup, responsiveness, minimal training for how to use the it, etc.

4.3.2 Intuitive (moderate, medium, high)

This KQI measures the simplicity of the platform from an end-user perspective. To develop an intuitive platform, the interface should somehow guide the user on whatever they try to achieve without requiring deep thinking; moreover, the platform should be adapted to end users' needs and the data produced by the platform should be in-line with the ways they're accustomed to seeing it.

4.3.3 Comprehensive interface (moderate, medium, high)

This KQI measures the comprehensiveness of the platform's interface (that included all buttons, commands, graphics etc.) in terms of e.g. simple Graphical User Interface, minimal explanation for how to use it, etc.

4.3.4 Satisfaction level (moderate, medium, high)

This specific KQI will identify the satisfaction rate of the end users that will handle and use the AIDERS platform.

4.4 Capacity & Resource Planning

4.4.1 System users (Number)

This specific KQI will identify the exact number of personnel from the end-user that are needed to safely and effectively operate the platform.

4.4.2 Resource allocation (moderate, medium, high)

This specific KQI will measure the overall contribution of AIDERS platform, according to resource planning and allocation (responders, vehicles, equipment, tasks) during an incident, versus the as is procedures followed up to that time.

4.4.3 Tactical or operational situation (moderate, medium, high)

This KQI will provide an overview of the level of awareness (operational picture, resource allocation, task allocation, current status of resources and mission, etc) that the emergency response organization has i) using, or ii) not using the AIDERS platform within the same timeframe.

4.5 Autonomy

This regards the level of independence of the system. An autonomous system is capable to operate (detect and process incidents) without human supervision (but human in the loop, if deemed necessary).

4.5.1 Automatic detection or estimation (per cent rate)

This KQI measures the percentage of successful automatic detections, predictions and estimations provided by the platform compared to the total points of interest.

4.5.2 Automatic decision-support (per cent rate)

Percentage of alerts automatically linked to recommendations on emergency management/response.

4.6 Interoperability

4.6.1 Integration with legacy systems (moderate, medium, high)

This KQI measures the level of integration of AIDERS platform with legacy systems (existing sensors, C2 of emergency response organizations) in terms of connectivity, functionality, etc.

4.6.2 Integration with different type of UAVs (moderate, medium, high)

This KQI measures the level of integration of AIDERS platform with different types and models of drones (e.g. multicopter, fixed wing, VTOL, etc.) in terms of functionality, responsiveness, reliability, etc.

4.6.3 Integration with different type of sensors (moderate, medium, high)

This KQI measures the level of integration of AIDERS platform with different types of sensors carried by a drone (e.g. Optronic sensor, Infrared sensor, Lidar, etc.) in terms of functionality, efficiency, etc.

4.7 Efficiency

4.7.1 Time to detect (Minutes)

This KQI measures the time difference -in minutes- i) using, or ii) not using AIDERS platform; the time will be measured from the time that an incident is communicated to responsible emergency organization to the time that the Command and Control Center is aware of the overall situation (e.g. with data related to the points of interest).

4.7.2 Reaction Time (percent)

This KQI measures the time difference between the reactions made by emergency response organization i) using, or ii) not using AIDERS platform; the time will be measured from the time that an incident is communicated to responsible emergency organization to the time that the response is completed.

4.7.3 Accuracy (moderate, medium, high)

This KQI measures the accuracy of the data provided to first responders by AIDERS platform compared to the actual situation. This can be calculated using the Precision and Recall measures.

4.7.4 System Performance

This KQI measures the system performance include the Bandwidth, CPU and memory consumption of the system.

4.8 Human Cost

4.8.1 Protect FR (moderate, medium, high)

This KQI measures the difference of the level of protection and human intervention offered to FR i) using, or ii) not using AIDERS platform, in terms of their involvement to risky or unknown situations.

4.8.2 Human casualties (Number)

This KQI measures the difference in numbers of human casualties i) using, or ii) not using the AIDERS platform.

4.9 Cost Effectiveness

4.9.1 Operational costs (Euro)

This KQI measures the difference (savings) in monetary terms i) using, or ii) not using AIDERS platform, including maintenance costs, salary costs, vehicle costs e.g. fuel, maintenance, etc.

4.9.2 Return on Investment (Euro)

This KQI measures the difference (savings) in monetary terms acquiring i) AIDERS platform, or ii) any other software, equipment, etc. that may completely or partially substitute the outcomes of AIDERS platform.

5 Traceability Matrix

A traceability matrix is used to primarily check, trace, evaluate the current quality indicators as well as to give feedback to technical partners every time that the system -and system's efficiency- is tested and the KQIs are measured. This will help to adjust some system specifications derived from first responders and from each test's lessons learnt. Thus, the table below includes all the KQIs that will evaluate AIDERS platform.

Test owners are often documented in a traceability matrix; however, in the framework of AIDERS project the responsible to keep trace of the metrics and to fill out the below matrix will be the demonstration owner together with AIDERS technical partners.

Indicator	ID	Secondary Indicators	Short Description	Metric	Evaluation Date	Score
	KQI1	False measure/data transmission/data treatment rate	How many times (percent) the system generates false alarms – False Positive Rate (FPR).	Per cent rate %		
Reliability	KQI2	Latency/Response Time	The time interval between the stimulation/cause and response/effect of AIDERS platform.	Millisecond		
	KQI3	Number of Failures (per cent rate)	How many times (percent) the system was able to be used without restarting or retrying.	Moderate, medium, high		
Robustness	KQI4	Time to restart after a failure	The time – differences in minutes that the system takes to restart after a failure.	Minutes		

	KQI5	Percentage of events causing a failure	Percentage of the events that will cause a failure in the system.	Per cent rate %	
	KQI6	Probability of data loss or corruption on failure	The rate of the data that will be lost or will corrupt on failure.	Per cent rate %	
	KQI7	Easy platform to use	The overall user-friendliness in terms of ease of deployment/setup, responsiveness, minimal training for how to use the it, etc.	moderate, medium, high	
Usability	KQI8	Intuitive	The simplicity of the platform from an end-user perspective.	moderate, medium, high	
	KQI9	Comprehensive interface	The comprehensiveness of the platform's interface (that included all buttons, commands, graphics etc.)	moderate, medium, high	
	KQI10	Satisfaction level	The satisfaction rate of the end users that will handle and use the AIDERS platform.	moderate, medium, high	
Capacity & Resource Planning	KQI11	System users	The number of personnel from the end-user that are needed to safely and effectively operate the platform.	Number	

	KQI12	Resource allocation	The contribution of AIDERS platform, according to resource planning and allocation (responders, vehicles, equipment, tasks) during an incident, versus the as is procedures followed up to that time.	moderate, medium, high	
	KQI13	Tactical or operational situation	The level of awareness that the emergency response organization has i) using, or ii) not using the AIDERS platform within the same timeframe.	moderate, medium, high	
Autonomy	KQI14	Automatic detection or estimation	The percentage of successful automatic detections, predictions and estimations provided by the platform compared to the total points of interest.	Per cent rate %	
,	KQI15	Automatic decision- support	Percentage of alerts automatically linked to recommendations on emergency management/response	Per cent rate %	
Interoperability	KQI16	Integration with legacy systems	The level of integration of AIDERS platform with legacy systems (existing sensors, C2 of emergency response organizations) in terms of	moderate, medium, high	

			connectivity, functionality, etc.		
	KQI17	Integration with different type of UAVs	The level of integration of AIDERS platform with different types and models of drones (e.g. multicopter, fixed wing, VTOL, etc.) in terms of functionality, responsiveness, reliability, etc.	moderate, medium, high	
	KQI18	Integration with different type of sensors	The level of integration of AIDERS platform with different types of sensors carried by a drone (e.g. Optronic sensor, Infrared sensor, Lidar, etc.) in terms of functionality, efficiency, etc.	moderate, medium, high	
Efficiency	KQI19	Time to detect	The time difference -in minutes- i) using, or ii) not using AIDERS platform; the time will be measured from the time that an incident is communicated to responsible emergency organization to the time that the Command and Control Center is aware of the overall situation	Minutes	

KQI20	Reaction Time (percent)	The time difference between the reactions made by emergency response organization i) using, or ii) not using AIDERS platform; the time will be measured from the time that an incident is communicated to responsible emergency organization to the time that the response is	Per cent rate %	
KQI21	Accuracy	Completed. The accuracy of the data provided to first responders by AIDERS platform compared to the actual situation. This can be calculated using the Precision and Recall measures.	moderate, medium, high	
KQI22	System Performance	The performance of the AIDERS system in terms of system performance and the technical requirements to run.	Bandwith is measured in bits per second	
KQI23			CPU consumption is measured in GHz (gigahertz)	
KQI24			Memory consumption is measured in bytes – typically megabytes (MB)	

Human Cost	KQI25	Protect FR	The difference of the level of protection and human intervention offered to FR i) using, or ii) not using AIDERS platform, in terms of their involvement to risky or unknown situations.	moderate, medium, high	
	KQI26	Human casualties	The difference in numbers of human casualties i) using, or ii) not using the AIDERS platform.	Number	
	KQI27	Operational costs	The difference (savings) in monetary terms i) using, or ii) not using AIDERS platform, including maintenance costs, salary costs, vehicle costs e.g. fuel, maintenance, etc.	Euro	
Cost Effectiveness	KQI28	Return on Investment	The difference (savings) in monetary terms acquiring i) AIDERS platform, or ii) any other software, equipment, etc. that may completely or partially substitute the outcomes of AIDERS platform.	Euro	

Conclusions

All the aforementioned capabilities and advantages will be tested, validated and used within AIDERS, as a holistic solution to address solution needs. In this deliverable, we have concluded in the most appropriate and valuable key quality indicators (KQIs), for evaluating the use of AIDERS solution. These KQIs, include mainly the reliability, robustness, usability, capacity and resource planning, autonomy, interoperability, efficiency, cost effectiveness and human cost. The identified KQIs will also be used to define the appropriate scenarios for the validation and evaluation procedures of the project.