SHUTTLE

SCIENTIFIC HIGH-THROUGHPUT AND UNIFIED TOOLKIT FOR TRACE ANALYSIS BY FORENSIC LABORATORIES IN EUROPE

PRE-COMMERCIAL PROCUREMENT (PCP)

TENDER DOCUMENT 2 (TD2) :

USE CASES AND SPECIFICATIONS

Deadline to submit an offer:

20th November 2019 at 12 p.m (EET)

This project has received funding from the European Union's Horizon 2020 Programme under Grant Agreement (GA) N° # 786913

This Tender Document 2 (TD2)-Annexes K and L, should be read in conjunction with other documents related to this Pre-Commercial Procurement (PCP), listed hereunder:

Tender Document 1 (TD 1): Call for Tenders

Tender Document 3 (TD 3): Background IPRs-Annex H

Tender Document 4 (TD 4): Tender Forms- Annexes A, B1, B2 & C

Tender Document 5 (TD 5): Technical Offer-Annex F

Tender Document 6 (TD 6): Financial Offer and Cost Breakdown-Annex G

Tender Document 7 (TD 7): Framework Agreement-Annex D

Tender Document 8 (TD 8): PCP Specific contract for Phase 1-Annex E

Tender Document 9 (TD 9): End of phase report-Annex I

Tender Document 10 (TD 10): Contractor details & project abstracts-Annex J

All documents are available on the SHUTTLE website www.shuttle-pcp.eu

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ANNEX K

USE CASES

In this ANNEX L, the three (3) different SHUTTLE Use Cases are analyzed. The Use Cases are based on specific descriptions delivered by the consortium partners.

These Use Cases are generic and will be used as a reference for the Implementation and Operational Validation of the SHUTTLE Solutions. These Use Cases explain how the SHUTTLE consortium intends to implement the toolkit into the forensic practise. These examples do not cover all aspects of the toolkit. Also, the scenarios include elements that may not be implemented during the current project. It is e.g. not foreseen that the SHUTTLE toolkit will be in use at non-specialised police laboratories during the project. Also, the implementation of a national or international database is not yet planned. However, the SHUTTLE toolkit to be developed should be prepared for these features.

They will be updated and defined in more detail, during the Phase 1 and Phase 2 of the contract. Moreover, it is stated that although a final version of the Use Cases must be delivered before the Phase 3 of the contract (in the Call off documentation of Phase 3), this version shall be subject to "last minute" changes whether due to the legislation regulating the end users' competences, the time available to conclude the evaluation and the level of cooperation with the relevant authorities etc. These changes shall not result in financial compensation or further delays in the scheduled delivery of the Use Cases as provided in the contract.

Use Case 1 Revenge

An unknown man is found dead in a quiet, residential area late in the evening. His clothing is recovered and tape lifts or other lifting systems by the police to collect microtraces. The tape lifts or other lifting systems are used and analysed in the next hours by the SHUTTLE microscope that has been acquired by the police station. The police laboratory worker is not specialised in trace evidence but has been trained to use the SHUTTLE microscope. The images are automatically saved in a national database, and a trace evidence examiner in the national forensic laboratory evaluates the data. Many pieces of glass are found on the clothing. Most of these are so small that they can hardly be seen by bare eye. Also, many black fibre traces have been recovered from the man's coat. The origin of these fibres is unknown, but their location and distribution indicate that they originate from an attacker. The police assumes that the incident may be related to a burglary a few blocks from the place where the victim was found. Policemen recover shards of glass originating from the broken window. During this investigation, they also note the black sweater of the inhabitant. The tape lifts or other lifting systems, shards and the sweater are all sent to the forensic lab for further study. The analyst isolates a number of glass particles from the tape lifts or other lifting systems: the SHUTTLE toolkit can classify glass, but not

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discriminate between glass from different sources. Isolation is however straightforward, as the coordinates of the particles are stored in the dataset acquired by the police. Some reference fibres ('known material) from the sweater are also analysed by the SHUTTLE toolkit. The analyst compares the properties of the fibres from the sweater and those on the tape lifts or other lifting systems, and finds they match in all investigated aspects. In addition, glass comparison also results in a match. Confronted with this information, the owner of the sweater admits that he chased a burglar that had entered his house, caught him, and kicked him until he collapsed.

Use Case 2 Dark matter

A woman is stabbed in a racially motivated attack in a shopping mall. The attack, caught on CCTV, lasted less than a second and did not involve any direct contact between the victim and the attacker. The CCTV footage leads to the arrest of a suspect within a few hours. The knife, found on the crime scene, the clothing (sweater, trousers) of the suspect, and tape lifts or other lifting systems lifts from the suspect's hands are sent by courier to the forensic lab. In the laboratory, the clothing is tape lifts or other lifting systems. Also, the microtraces found on the knife are transferred to tape lifts or other lifting systems. All tape lifts or other lifting systems such as (knife, suspect's clothing and hands) are analysed by the SHUTTLE microscope.

This analysis shows that the hands of the suspect contain several polyester fibres with an intense dark colour. Identical fibres are found on the handle of the knife. A European wide database search for these fibres reveals that similar fibres have been found in a glove that was analysed by a different SHUTTLE microscope in an unrelated case elsewhere in Europe. It has been assumed that the suspect wore gloves during the attack but discarded them afterwards. Instantly, policemen search the road from the shopping mall to the suspect's home. In a trash can, two gloves are found. These are tape lifts or other lifting systems and analysed by the SHUTTLE toolkit. Between the many fibres on the tape lifts or other lifting systems, the SHUTTLE toolkit locates small spots that are classified as blood. The analyst cuts out the area of the glove where the blood traces originated from. DNA analysis reveals a profile matching that of the victim.

Use Case 3 Casual encounter

In a case investigation, the suspect and the victim are neighbours and may have had a legitimate contact in the hours before the victim was killed. Due to these earlier contacts, it becomes of paramount importance to discriminate the trace distribution after the possible legitimate encounter and an attack. The forensic expert asks forensic students of a national high school to carry out reconstructions. The students reproduce the scenarios put forward by the suspect and by the prosecutor. During these tests, the students wear highly fluorescent

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clothing to facilitate easy analysis. After the tests, tape lifts or other lifting systems of the clothing are taken and analysed by the SHUTTLE toolkit present at the high school. The fluorescence enables quick and easy classification of the transferred microtraces. Within 30 days, the students report on the distribution of fibres traces following a fight and a casual encounter (as described by the suspect). The images provided by the students, created using the SHUTTLE toolkit, clearly show where transferred fibres can be expected. The forensic expert compares these images with the distribution of fibres found in the case and concludes that the trace distribution is consistent with a legitimate encounter, but not with the scenario put forward by the prosecution.

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ANNEX L

SPECIFICATIONS

In the text below, the SHUTTLE Objectives are described in detail.
Each Objective consists of several specifications, whose purpose is to encourage Tenderers to provide sufficient information describing how each specification will be achieved.
For the assessment procedure, the Scoring Model for the Award Criteria in Section 3.4 will be applied.

In the Technical Offer (in Annex E), Tenderers need to make clear how they intend to achieve the specifications, providing sufficient information.

Moreover, in the text below the word "traces" refers collectively to traces from Blood, Fibres/Hair, Glass, Saliva, Sand/soil, Skin cells, unless otherwise is clearly stated.

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1. Contract Implementation

Objective 1. Feasibility of the contract implementation plan and schedule

The purpose of the contract assessment and control process is to determine the status of the contract and contract execution plan in order to ensure that the contract performs according to the plan and schedule to satisfy technical objectives. This process evaluates the progress, achievements and business objectives (contrasting them with the requirements and plans), periodically and at major events. Information is communicated for management's action when significant variances are detected. This process also includes redirecting the contract activities and tasks, as appropriate, to correct identified deviations and variations from the Contract Management Plan. Redirection may include re-planning when appropriate.

The Tenderer shall provide contract management processes and tools adequate for monitoring and evaluating the progress achieved in the execution of the contract phases. The main objectives of these processes are:

Continuous monitoring of the contract progress.

Early identification of problems and successes.

Evaluation of contract's achievements.

The methodology provided by the Tenderer shall be based on a comprehensive list of well-defined milestones and the set of pre-defined procedures shall ensure that these milestones are successfully reached.

PMSPEC1.1 Contract management plan (milestones, deliverables, work breakdown structure, etc.)

A Project Management Plan (PMP) according to popular methodologies (e.g. PMI, PRINCE 2), including all the deliverables table of contents shall be included in the proposal. At least the following contents shall be well identified in PMP:

Project scope definition

Toolkit Specifications

Service deployment lifecycle

Testing approach

Quality Management approach

TRL Assessment

Constraints

Human resource requirements

Material/equipment requirements

Change management plan

PMSPEC1.2. Progress report shall be delivered to the Contracting Authority by E-mail.

The Tenderer shall propose a complete reporting strategy taking into consideration that:

Current versus planned status

Main achievements

Main problems and mitigation actions

Points to be taken into account by Buyers

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Objective 2. Methodology of the Contract Implementation, including risk management and quality assurance

PMSPEC2.1. Risk management plan. The Tenderer shall define a risk management plan, describing how risk management will be structured and performed on the contract implementation. During the contract implementation, the Tenderer shall gather the potential risks details (technical, operational, managerial, etc.) which can appear during the contract execution. For each potential risk, the Tenderer shall assign the estimated probability and the expected impact as well as proposing the most adequate mitigation strategy to reduce or mitigate the risk.

PMSPEC2.2. Contract implementation methodology (work team composition, accredited experience, subcontracting, etc.)

The Tenderer:

Shall provide a complete work team organization description. Such description shall include a clear view of the roles and responsibilities defined for the contract implementation, highlighting the strong points of the working team that justifies its suitability for this particular contract.

Shall accredit experience in forensic sector services or relevant fields.

Shall take care of all the subcontracting tasks, associated with the certification of the external Data and Service Providers or the provision of modules of the Toolkit. This shall include:

The drafting and consolidation of a Service Level Agreement (SLA) document that allows the Toolkit to meet the expected performance.

The promotion of a certification procedure for each external entity.

Tracking of the proper service provision.

The Tenderer shall specify which services can be delivered and which are foreseen to be covered by potential third parties via the Subcontracting declaration.

Documentation shall be provided in electronic format compatible with MS Office 2010 (or equivalent) as long as not otherwise agreed with the Contracting Authority.

Documentation and milestones included in CfT documentation (section xxx) are mandatory: Any documentation concerning tenderers that could be requested by European Commission over PCP implementation shall be generated.

PMSPEC2.3. Quality assurance. The Tenderer shall describe, in their proposal, the development process including the involvement and feedback from the Contracting Authority and the quality assurance of the contract outcome.

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2. Functional

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	OBJECTIVE 1: The Toolkit provides a system to recover traces efficiently using tape lifts or other lifting systems
FSPEC1.1	If the lifting system is a tape system, it shall consist of at least an adhesive tape system and a backing.
FSPEC1.2	The tape system or any other lifting system shall be cuttable using scissors and guillotines. (If the lifting system is a tape system).
FSPEC1.3	The adhesive tape system or any other lifting system shall have an adhesive strength comparable to current tape systems used of traces recovery (5-12N/25mm).
FSPEC1.4	The tape system or any other lifting system shall be possible to be handled while wearing personal protection gloves.
FSPEC1.5	The tape system or any other lifting system shall be below 1mm thick.
FSPEC1.6	Recovery of traces shall be comparable to traditional tape systems. (Fibres recovery >90%)
FSPEC1.7	The tape system or any other lifting system shall be non-selective; it shall not fractionate the traces but shall recover all types traces.
FSPEC1.8	The tape system or any other lifting system shall have a shelf life of at least three years.
FSPEC1.9	The tape system or any other lifting system shall allow to be stored at 50 $_{o}$C for at least three months without altering the condition of the traces.
FSPEC1.10	The tape system or any other lifting system shall be possible to be applied at -5$_{o}$C (Compliance with FSPEC1.2, FSPEC1.3, FSPEC1.4, FSPEC1.6, FSPEC1.7).
FSPEC1.11	It shall be possible to examine the tape system or any other lifting system after long term storage (10 years) in dark and dry environment.
FSPEC1.12	The backing shall be adequately stiff comparable to traditional tape systems so that the tape system is not easily damaged. Also, the backing shall be light, so that it does not hinder manual handling. (If the lifting system is a tape system).
FSPEC1.13	The tape system or any other lifting system shall be able to collect microtraces on various surfaces: flat, curved, uneven.
FSPEC1.14	The exterior surfaces of the tape system or any other lifting system shall be cleanable. The appropriate method to perform cleaning without damaging the surfaces shall be defined by the Tenderer.

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	OBJECTIVE 2: The Toolkit allows further analysis of recovered traces using tape system lifts or other lifting systems
FSPEC2.1	Traces in the tape system or any other lifting system shall be possible to be visualized in a contrast and detail that is comparable to conventional glass slides.
FSPEC2.2	The tape system or any other lifting system shall have a transmission of >90% for light in the visible range and a transmission of at least 50% for light in the Ultra-Violet (UV) range (300 – 400nm).
FSPEC2.3	The tape system or any other lifting system shall be non-polarizing. Compensation of tape system's or any other lifting system's birefringence by any mean is also an acceptable solution.
FSPEC2.4	The tape system or any other lifting system shall be non-fluorescing.
FSPEC2.5	Isolation of traces from the tape system or any other lifting system shall not lead to fracture of sensitive traces such as hairs and fibres. Dissolution or softening of the glue layer is allowed, provided that the solvent used is gentle, preferably water or ethanol.
FSPEC2.6	It shall be possible to cut out small pieces or isolate in another way of the tape system or any other lifting system (including a selected trace and preferably the backing) to perform analysis with other techniques.
FSPEC2.7	The tape system or any other lifting system shall not contain pigments or fillers (that may interfere with elemental analysis).
FSPEC2.8	The tape system or any other lifting system shall be DNA free.
FSPEC2.9	The tape system or any other lifting system shall not contain materials that inhibit or deteriorate the PCR process.
FSPEC2.10	The tape system or any other lifting system shall prevent the introduction of or contamination by extraneous materials during transport or storage. The use of a protective film is allowed.
FSPEC2.11	Microscopic examination of the tape system or any other lifting system shall not deteriorate biological samples, specifically DNA analysis.
	OBJECTIVE 3: The Toolkit contains an automated microscope that provides images in various illumination modes

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FSPEC3.1	Morphological features of traces with a size of 10 µm shall be easily distinguished from the background in the M images acquired by the microscope.
FSPEC3.2	In addition to the microscopic images, images in specialised illumination modes shall be acquired, including transmission spectrometric imaging (S), reflection (R), fluorescence (F), and polarisation (P) imaging.
FSPEC3.3	In these specialised modes (FSPEC3.2), traces with a size of 10µm or less shall be possible to be analysed.
FSPEC3.4	In these specialised modes (FSPEC3.2), data need not be acquired for the whole field of view: background pixels, i.e. pixels that do not contain information of any trace, may be excluded. The number of traces, as described in FSPEC3.1, that are not analysed shall be lower than 2 %.
FSPEC3.5	In these specialised modes (FSPEC3.2), the coordinate system used shall be directly related to the coordinate system used for M images, so that the specialised analyses can be traced accurately to a position in the M images.
FSPEC3.6	In these specialised modes (FSPEC3.2), the analysis positions shall be identical for all specialised modes.
FSPEC3.7	The output shall consist of a single image or data set per illumination mode. Mapping and stitching of images is allowed.
FSPEC3.8	For S images, the spectral range shall be 320-720 nm or broader.
FSPEC3.9	For S images, the spectral resolution shall be 10 nm or better.
FSPEC3.10	For S images, noise level in these images shall be below 4% (transmission scale).
FSPEC3.11	Acquisition of S images shall have a high dynamic range (12 bit or higher).
FSPEC3.12	The sample shall be possible to be illuminated by UV light at 365 nm (±3nm) to acquire F images. (Full spectrometric analysis is allowed).
FSPEC3.13	R and F images shall have at least Red-Green-Blue (RGB) detection or equivalent. (Full spectrometric analysis is allowed).
FSPEC3.14	For R images, the image shall not be disturbed by direct reflection of the tape system or any other lifting system e.g. darkfield illumination.
FSPEC3.15	Birefringence shall be calculated from the P images. The retardation shall be possible to be measured up to 6000 nm with an accuracy of 20 nm or better. The method used to calculate the birefringence shall be described.

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FSPEC3.16	All data acquired shall be rotation insensitive. This includes the calculated birefringence values.
FSPEC3.17	The instrument shall be driven by a computer and software and does not require user intervention after the acquisition is started.
FSPEC3.18	The software shall be able to store and retrieve default acquisition parameters (e.g. illumination modes, spectral range, wavelength for fluorescence, magnification). The parameters shall be possible to be tuned to suit advanced or non-routine analysis.
FSPEC3.19	The software shall include a data viewer, in which data acquired (raw (coordinates, spectra), calculated (birefringence, retardation value), specialised analysis (R, F, P)) can be viewed and checked visually.
FSPEC3.20	The software includes a data viewer, in which images can be zoomed in and out completely (i.e. The user is able to distinct between individual pixels).
FSPEC3.21	The software shall include a data viewer, in which colour images of S or M data can be displayed. The colour values shall be based on the S spectra or on additional colour acquisition of M images, or both.
FSPEC3.22	The software shall include a data viewer, in which S spectra from single pixels or a selection of pixels can be displayed, extracted and saved, e.g. in a .csv format.
FSPEC3.23	The acquisition parameters acquired data and calculated data shall be stored together, e.g. in a single file, or related in a single database. Data shall be stored as raw data (filtering of background pixels is allowed).
FSPEC3.24	The software shall store acquired datasets in such a way that it can be read by normal programming languages (e.g. MatLab, Java, Python). If data is stored in ordinary computer files, a standard format, such as NETCDF is preferred. If a proprietary data structure is used, libraries or instructions to extract data from these files shall be supplied. Direct insertion of acquired data into a database is also acceptable. This can be a general-purpose database such as MySQL or PostgreSQL, or a more specialised database such as SciDB.
FSPEC3.25	In-focus images described in FSPEC3.2 of the majority of the traces (>95% for normal cases) on the tape system or any other lifting system shall be possible to obtain.
	OBJECTIVE 4: The Toolkit converts acquired images to information (IP)
	Algorithm or combination of algorithms

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FSPEC4.1	The algorithm or combination of algorithms shall accept data (or info on the location of data) from the GUI. See also FSPEC5.3 and FSPEC5.4).
FSPEC4.2	The algorithm or combination of algorithms shall validate whether the input data is compatible with the algorithm.
FSPEC4.3	The algorithm or combination of algorithms shall localise, analyse and classify traces in images.
FSPEC4.4	The algorithm or combination of algorithms shall return results to the GUI.
FSPEC4.5	The algorithm or combination of algorithms shall determine the outline of a trace (decides which pixels in an image belong to a specific trace).
FSPEC4.6	The algorithm or combination of algorithms shall determine a number of geometric parameters for every trace, such as the length, width and surface area. For fibre and hair traces, this may imply skeletonizing and/or tracing along the length, so that the real length is calculated. Geometric calculations shall be valid on small scale (µm), but also for larger traces (up to several centimetres).
FSPEC4.7	The algorithm or combination of algorithms shall determine the optical properties (see objective 3 for a list of imaging modes to be implemented) for every trace from the inserted images and the advanced analyses in S, P, F and R modes. For smaller traces, a single set of parameters shall be made available (depending on the effective pixel size of the solution and the size of the trace). For larger traces, a larger number of analysis shall be available. In such a set, data may be combined (e.g. averaged) such that the effective measurement spot becomes 50µm. This implies that an array of optical properties shall be returned for larger traces. Each of the members in such an array shall be related unambiguously to the trace.
FSPEC4.8	Every item in this array shall contain averaged data of the direct surroundings of the central position. The averaged data shall include the coordinates, the transmission spectrum, the reflectance, and the retardance. Also, the number of averaged pixels and the variation between them (e.g. as a standard deviation) shall be included.
FSPEC4.9	Measurement errors for geometrical analysis shall not exceed 5%.
FSPEC4.10	The image processing procedures shall take overlap, crossings, or adjacency into account. Overlapping areas shall be excluded for optical measurements.

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FSPEC4.12	Accuracy to distinguish overlapping, joining or adjacent traces shall be >90% for cases where such situations are obvious for a human examiner.
FSPEC4.13	In addition to morphologic and optical properties specified above, the algorithm or combination of algorithms shall classify every trace into classes that overlap with the traces. Additional categories are allowed.
FSPEC4.14	The classifier shall include an 'unknown' category (trace not known) and an 'overload' category (image too crowded for useful analysis)
	OBJECTIVE 5: The Toolkit shall include a Graphical User Interface
FSPEC5.1	The GUI shall provide the options to store data in local folders as well as to the database (only for certified users).
FSPEC5.2	The GUI shall allow the user to select datasets (acquired by the automated microscope) and to initiate processing of these datasets by the algorithm or combination of algorithms.
FSPEC5.3	The GUI shall allow the user to select parts of datasets (selected imaging modes, cropped images, selected spectral ranges).
FSPEC5.4	The GUI shall handle the data acquired with standard settings of the automated microscope (see FSPEC 3.19). In addition, data acquired with non-standard acquisition protocol of the automated microscope can be handled.
FSPEC5.5	The GUI shall be able to connect to the supplied algorithm or combination of algorithms, but also to alternative algorithms or combination of algorithms from external sources developed outside the SHUTTLE project.
FSPEC5.6	The communication between the GUI and the algorithm or combination of algorithms shall be open. Clear instructions on how to include alternative algorithms or combination of algorithms shall be provided.
FSPEC5.7	The GUI shall allow the user to select the database where results will be stored. This database, specified further in **OBJECTIVE 6**, shall be installed on the same computer or on a different computer (the choice for installation will be made by the end users). Data stored in the database shall be read by the GUI and used in the same way as data retrieved from the algorithm or combination of algorithms.
FSPEC5.8	In the GUI, a user shall be able to select one or more algorithms or combination of algorithms. Data shall be then processed by each of the selected algorithms or combination of algorithms.

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FSPEC5.9	The results of the algorithm(s) or combination of algorithms shall be presented to the user as a table. This table shall include all traces localized by the algorithm or combination of algorithms, including their coordinates and classification.
FSPEC5.10	The GUI shall provide the option to present the results of the algorithm(s) or combination of algorithms as an overlay on the original images.
FSPEC5.11	The results of the algorithm(s) or combination of algorithms shall be inserted into the database (see below) via the GUI. The GUI shall be able to cope with a secure access management of the database. This implies at least a password protected access and encrypted communication with the database.
FSPEC5.12	The calculations shall be scalable and independent of the coordinate system of the images.
FSPEC5.13	Users shall be able to load images acquired with other techniques, e.g. images acquired by a camera on a conventional microscope (jpeg, tiff).
FSPEC5.14	The user shall have the option to view the loaded image.
FSPEC5.15	The GUI shall provide an overview window of the total number of the acquired images (of the tape system or any other lifting system), so as the user can select any of the individual images to be viewed.
FSPEC5.16	The GUI shall provide the option to view the spectrograph of the chosen pixel area in a separate window eg. pop-up window.
FSPEC5.17	GUI shall have the ability to control all the different software tools that are needed for the SHUTTLE Toolkit operation.
FSPEC5.18	There shall be a functionality that allows raw data to be imported from external sources.
FSPEC5.19	The user shall have the option to fully configure the parameters on which the calculation is based through the GUI.
	OBJECTIVE 6: The Toolkit stores and queries data and helps in its interpretation
	Database storage
FSPEC6.1	The DB shall store raw data sets acquired by the automated microscope.
FSPEC6.2	The DB shall contain the results of the image processing tools.
FSPEC6.3	The database shall be extendable and new techniques / features can be added.

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FSPEC6.4	The database shall make use of the latest version of open source databases (e.g. MySQL, PostgreSQL, MariaDB)
FSPEC6.5	The database shall provide the option to manage users (add, delete, edit) and their access rights by administrators not related to the SHUTTLE supplier.
FSPEC6.6	The database shall be extendable. Data acquired by other techniques, such as a microscopic description, FTIR, and MSP can be imported.
FSPEC6.7	All analysis results stored in the database shall be traced unambiguously to the item from which they were acquired.
FSPEC6.8	The database architecture shall be such that it can, (or can easily extended to), host several thousands of analyses by the automated microscope as well as the results of the image processing routines.
FSPEC6.9	Backup policy shall be provided in order to prevent data loss events.
FSPEC6.10	The database shall be able to be hosted by a commercial supplier (not related to the SHUTTLE supplier) after the contract implementation.
FSPEC6.11	The database shall be secure up to modern standards.
FSPEC6.12	The database shall have various levels of access rights for viewing data, entering data, and validating data.
FSPEC6.13	The database shall automatically create log files containing all the actions performed by users (providing timestamp, ID and changes made to DB).
FSPEC6.14	General information on the background of data, such as the nature of the donor item, shall be entered in a standardized way.
	Data extraction
FSPEC6.15	Data used for the data representations shall be possible to be extracted from the database, preferably using a graphical query builder. Example queries are: 'select all traces that have been classified as glass', 'select microscopic images M of all traces that were classified as 'unknown' in all datasets acquired in the last week', 'select all fibres from a specified dataset that contain colour spectra that are comparable to a specified known sample'.
FSPEC6.16	Queried data may consist of data from a single dataset or data from a larger number of datasets.

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FSPEC6.17	Queried data shall at least consist of the images from microscopic images M, analysis data from S, P R, or F images, or results from image processing routines.
FSPEC6.18	Queried data shall be saved as a text file, csv file or binary file with a known and documented structure.
	Data representation
FSPEC6.19	Data extracted from the database shall be processed to yield a list or table of all traces found in a specific item or analysis. This list can be used to devise the further examination strategy. Also the list can be used to check or validate the results shown in the overview, e.g. by conventional microscopy.
FSPEC6.20	Data extracted from the database shall be processed to yield a measure of similarity between two (sets of) traces. This shall be a user selectable function in the GUI.
FSPEC6.21	Data extracted from the database shall be processed to yield an indication of the rarity of a target trace in the (selected records of) the database. This shall be a user selectable function in the GUI.
FSPEC6.22	Data extracted from the database shall be processed to yield a calculation of the evidential value of a result. This shall be a user selectable function in the GUI.
FSPEC6.23	Data extracted from the database shall be processed to yield an indication of the number of traces that are similar or identical to a specific trace or fall within the variation of a set of traces. This shall be a user selectable function in the GUI.
FSPEC6.24	Data extracted from the database shall be processed to yield an image of the tape system or the lifting system where traces that are similar or identical to a specified trace are highlighted, so that the original distribution of these traces can be assessed (also see FSPEC5.10). This shall be a user selectable function in the GUI.
FSPEC6.25	Data extracted from the database shall be processed to yield a measure of the heterogeneity of the extracted data. This shall be a user selectable function in the GUI.
	Exchange and collaboration
FSPEC6.26	The database shall be possible to be installed and accessed in different locations. These may act as independent databases. Synchronising is currently not required.
FSPEC6.27	Transfer of data between different installations of a potential server shall be possible.

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FSPEC6.28	The database shall not contain case information, such as names of suspects, case file numbers, etc. It is based on items identified by a unique internal key structure.
FSPEC6.29	Database shall be based on open source software or shall be at least accessible by standard software, such as MATLAB, Python and R.
FSPEC6.30	Data shall be marked as 'validated' by certified users before stored to the database.
FSPEC6.31	It shall be possible for users to comment on items or datasets, e.g. to indicate flaws.
	OBJECTIVE 7: Toolkit practical issues to be met
FSPEC7.1	The area of the tape system or any other lifting system to be used for recovery can be varied. Tape systems or any other lifting systems of varying size can be analysed by other parts of the Toolkit. A ROI shall be selected before acquisition with the automated microscope. Cropping of data after acquisition shall be possible (so that only a part of the data is processed by the image processing routines). The maximum size to be considered shall be A4.
FSPEC7.2	The system shall be fast. The system shall be able to process (modes as indicated in FSPEC3.2) a A4 sized tape system or any other lifting system in less than 5 hours without user intervention.
FSPEC7.3	Automatic feed of the tape systems or any other lifting system to the microscope for subsequent scanning shall be provided for at least four A4 tape systems or any other lifting systems without user intervention.
FSPEC7.4	The system shall be safe to use. The system shall be compliant with clauses 6) Protection against el. Shock; 7) Protection against mechanical HAZARDS; 9) Protection against the spread of fire and 10) Equipment temperature limits and resistance to heat of EN 61010-1:2010 +A1:2019 "Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements"
FSPEC7.5	Individual components (commercial products) of the Toolkit shall be compliant with applicable EU safety standards.
FSPEC7.6	Moving parts, high intensity illumination, and other parts that may injure analysts shall be shielded where possible and shall be possible to be shut down instantaneously using a single emergency button.
FSPEC7.7	The tools can be used and correctly operated in the intended environment (Ambient temperature: 15^{o}C - 35^{o}C; Relative humidity: 20% - 70%(30^{o}C)).

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FSPEC7.8	The microscope apparatus shall fit in area not exceeding 2 m_2.
FSPEC7.9	None of the microscope apparatus' dimensions shall exceed 2 m.
FSPEC7.10	The microscope apparatus shall not weigh more than 100 Kg.
FSPEC7.11	None of the Toolkits components shall emit noise exceeding 85db(a) SPL.
FSPEC7.12	The Toolkit shall be accompanied by a Full HD monitor screen at least 20''.
FSPEC7.13	The Toolkit shall be able to operate with normal mains power (220 - 240 Vac, 50 - 60 Hz).
FSPEC7.14	The Toolkit shall have the appropriate means of connection to the mains (cable & plug).
FSPEC7.15	The hardware of the computer which will be provided shall be designed properly so as all the needed calculations and operations be performed seamlessly in time.
FSPEC7.16	Software with hardware compatibility shall be guaranteed.
FSPEC7.17	The tenderers shall provide all the necessary equipment and components for the correct operation of the SHUTTLE Toolkit.
FSPEC7.18	The SHUTTLE Toolkit shall be comprised of all relevant parts that are necessary for its correct operation.
FSPEC7.20	All the documentation and GUI will be at least in English.
	OBJECTIVE 8: Minimisation of classification
FSPEC8.1	The algorithm or combination of algorithms shall provide, among the results, a measure for the certainty or uncertainty of a trace classification.
FSPEC8.2	The Tenderer shall built the Toolkit in such way that it will minimise the classification errors. Specific acceptable classification errors will be provided in due time.

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3. Non-Functional

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	OBJECTIVE 1: Quality and traceability
NFSPEC1.1	The automated microscope shall be automatically calibrated, so that the data acquired by the microscope (intensities, coordinates etc.) are corrected for temporal variations or ageing of the equipment.
NFSPEC1.2	The automated microscope shall be robust and work on specification for at least 4 days without the need for manual adjustments. If periodic manual adjustments (after the 4 days period) are needed for optimisation, a clear description shall be provided.
NFSPEC1.3	Action performed by the Toolkit shall be registered automatically. This implies that datasets generated by the Toolkit, results of the data processing routines, and data representations contain information on the user performing the action, the time of action, the used instrument/database, and the used method/algorithm or combination of algorithms shall be stored. All data shall be possible to be traced back to the item(s) and tape system system(s) or lifting system(s) from which data where acquired. Recovery with tape system or lifting system(s) is traceable as well, but this registration need not be automatic.
NFSPEC1.4	Tape systems or other lifting systems shall obtain a unique label. Labelling may be carried out after recovery of traces. The used labels, e.g. a QR code or barcode, shall recognized by the automated microscope, and the identity of the tape system or the lifting system is stored with the analysis.
NFSPEC1.5	Users shall be able to check actions performed by the Toolkit. For every trace classification mentioned in data extracted from the database, the user shall be able to a) check which algorithm or combination of algorithms was used for classification; b) display the images of this trace acquired by the microscope. The trace to be checked in these images is highlighted or marked; c) go back to the tape system or the lifting system to observe the trace microscopically or isolated it for additional investigation. This implies that the coordinates used by the microscope and the mentioned in the database shall be used to find the correct location of the trace on the tape systems or any other lifting systems
NFSPEC1.6	The supplied software tools have clear access rights for different tasks. The Toolkit shall include an advanced security technology, providing different levels of access to end-users and admin.
NFSPEC1.7	The Toolkit shall integrate flexible, reliable and extendable systems.
NFSPEC1.8	The Services shall be able to continue operating despite receiving and processing invalid or wrong data. Thus, all services shall inform the End-User in case of any relevant occasions.

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NFSPEC1.9	High availability of the Toolkit shall be ensured, being robust enough to external factors (e.g. server crash).
NFSPEC1.10	During the elaboration of the technical offer, the candidate Tenderer shall provide a document (Quality Control Plan) on how the quality control of data will be internally handled during the operation of the services (Phase 3 and onwards). The tenderer shall abide to quality control measures. Further to this and in order to ensure high quality standards, the Tenderer shall include additional data quality measures or even commits to reach higher data quality thresholds. The tenderer shall use as minimum related ISO standards for data quality and most the commonly used data quality elements.
NFSPEC1.11	The Toolkit shall provide high computing availability, having a continuous, uninterrupted, fault tolerant Solution.
	OBJECTIVE 2: Modularity and integration
NFSPEC2.1	The tools in the SHUTTLE Toolkit shall be integrated in a clear and user-friendly manner. It shall be possible to use individual tools of the Toolkit with other (non-SHUTTLE) tools.
NFSPEC2.2	Software for different tools (image acquisition, image processing, database access) shall be combined into a single package or at least designed such that ease of use is guaranteed (Similar look and feel).
NFSPEC2.3	The Toolkit shall process traces that are recovered using other media than the SHUTTLE tape or any other lifting system. This could be the tape systems that are currently in use in the forensic labs, e.g. in cold cases or samples on glass slides and tape system or any other lifting system up to 3mm thick.
NFSPEC2.4	The user shall be able to interact with the automated microscope, the image processing software, and the database software from a single computer.
NFSPEC2.5	The database and the image processing routines shall also be possible to be accessed from other computers.
NFSPEC2.6	All interfaces shall follow modular and preferably based on open systems, ensuring the expandability of the system
NFSPEC2.7	The system shall be as dynamic as possible serving future needs (posing any issues in any system modification/extension) such as expandability and maintainability.
NFSPEC2.8	The solution shall be fully scalable so that it can easily be adapted to new integration needs or changes in performance, reliability and data volume requirements.

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NFSPEC2.9	Both modularity of each component and communication between modules shall be ensured.
	OBJECTIVE 3: Training
NFSPEC3.1	The Toolkit shall be accompanied by a user manual that covers all the relevant operational aspects.
NFSPEC3.2	The Tenderer shall train End-Users about the exploitation of the solution by the generation of the training material without additional costs for the Contracting Authority.
NFSPEC3.3	The Tenderer shall train End-Users about the exploitation of the solution by the execution of the training sessions without additional costs for the Contracting Authority. Training courses shall take place in PCP phase 3 of the contract. A course of a minimum length of 48h for at least 6 persons with User role will have to be provided. It will be a 'plus' of the proposal if the Tenderer provides more courses. The Tenderer shall pay for all costs derived from the journey of End-Users (if needed) to attend the courses and/or the web platform that will host the training sessions.
NFSPEC3.4	Training courses shall take place in PCP phase 3 of the contract.
NFSPEC3.5	Training documentation, workshops and user manuals will be all at least in English language.
	OBJECTIVE 4: Maintenance
NFSPEC4.1	The Tenderer shall inform all End-Users about downtimes of the services at least a week in advance.
NFSPEC4.2	The maintainability described as a measure of how quickly and effectively a service, component can be restored to normal working conditions after a failure shall be: $Maintainability(MTRS\ in\ hours) = \frac{Total\ downtime\ in\ hours}{of\ service\ breaks} \leq 2\ hours\ Number$
	OBJECTIVE 5: Solution Technology Readiness
NFSPEC5.1	PCP contracts cover a specific part of the innovation cycle; therefore, the Solution's TRL at the beginning of the contract shall be preferably 4 or 6. The tenderer shall demonstrate the evolution of this TRL level

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	throughout the contract lifecycle, aiming at the end of PCP phase 3 to reach TRL 8.
NFSPEC5.2	The Tenderer shall commit to provide, if it is required by the SHUTTLE Consortium, the supporting information that properly justifies the Technology Readiness Level (TRL) that initially claimed for the Solution. Definitions of the TRLs, description and required supporting information are included in the "DoD TRA Deskbook (2009)".
	OBJECTIVE 6: User Experience
NFSPEC6.1	The Toolkit shall be designed in such a way that users experience the Toolkit as a unity.
NFSPEC6.2	The user shall experience the Toolkit as an easy-to-use unity.
NFSPEC6.3	The user shall be able to replace part of the Toolkit with other tools. The consortium encourages solutions in which the tools can be used individually and is compatible with insertion of data/samples from other sources or exports to other tools. This affects all tools in the Toolkit, be it in different ways.
NFSPEC6.4	Regarding the software tools, all the interaction with users will be done through the dedicated GUIs.
NFSPEC6.5	The Toolkit shall be usable. Usability is concerned with enabling users to effectively and efficiently achieve their end objective with the product.
NFSPEC6.6	Practitioner evaluation and acceptance. The tenderers shall provide their individual view for the applications to be performed, which will support the use case scenarios in the pilot. This will allow practitioners to evaluate the benefit of the proposed solutions.

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4. Commercial Feasibility

Objective 1 Exploitation Plan - Short to Mid-Term exploitation plan, including a commercialisation strategy. Completeness, sense of reality and feasibility of the commercialisation plan including the market analysis and risk management
Objective 2. Commercial Viability. Sense of reality and feasibility of the principles for licensing, pricing, packaging, distribution.

The Tenderer shall develop at each PCP phase a short to mid-term exploitation plan, including a commercialisation strategy considering other acquisition modalities different to direct purchase (e.g. provision services, leasing of equipment, renting of equipment, co-ownership, etc.) and the roadmap designed to take each Service to market.
A detailed risk management plan shall also be presented. In order to elaborate on the market, the Tenderer shall provide a detailed market analysis based on the insights provided in the Tender documentation (section 2.10.3. Commercial exploitation of results).
Moreover, this study shall describe indicatively and in detail:

the Services,

the conditions for contracting or acquiring this product,

costs breakdown,

potential market

etc.,

indicating whether the full solution or parts of it can be used. If only parts of the solution can be used, the selected parts have to be obviously able to function as a separate set.

The study shall also show the potential re-usability and extensibility of the Toolkit or parts of it regarding End-User type and domain (other than forensics sector).

5. Evaluation of the solution and sustainability of testing

The Tenderer should define in detail the plan for the Operational Evaluation of the final Solution in alignment with what is described for the testing in Phase 3 in the CfT documentation.

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