This project that has received funding from the European Union's Horizon 2020 - Research and Innovation Framework Programme, H2020-FCT-2015, under grant agreement no 700381.

Analysis System for GAthered Raw Data

ASGARD

Instrument: Research and Innovation Action proposal

Thematic Priority: FCT-1-2015

D2.4. Design of the certification programme

Deliverable number	2.4	
Version:	1.0	
Delivery date:	31 August 2017	
Dissemination level:	Public	
Classification level:	N/A	
Status	Final	
Nature:	Report	
Main author(s):	Pavel Gladyshev	NUI UCD
Contributor(s):	Berto Santos, Anabela Filipe	PJ
	Michele Colajanni	UNIMORE

DOCUMENT CONTROL

Version	Date	Author(s)	Change(s)
0.1	15 August 2017	Pavel Gladyshev	Initial draft
0.2	28 August 2017	Pavel Gladyshev	Major rewrite of Sections 2, 3, and 4.
0.3	29 August 2017	Romaios Bratskas	Quality Review of the deliverable
1.0	31 August 2017	Pavel Gladyshev	Incorporation of reviewers' comments

DISCLAIMER

Table of Contents

Annexes

Tables

1. Introduction

1.1. Overview

One of the key objectives of ASGARD project is to facilitate the adoption of the technologies and tools it will produce. Training and education of stakeholders is an important step towards achieving that goal.

The DoA describes this deliverable as:

> "*D2.4 – This deliverable presents the design of the training and certification programme of the ASGARD tools*." The work package description further clarifies that "*the design of the certification programme will include the mechanisms for further development of training material and topics of technological and domain interest*."

Given that the project is still in early stages (M12), it is not yet possible to produce a comprehensive syllabus for the ASGARD certification and training. Thus, this document lays down the core ideas, principles, and approaches that will be used to develop certification and training materials for the deliverable D2.5.

1.2. Relation to other deliverables

This deliverable is related to the following other ASGARD deliverables:

Receives inputs from: None

This deliverable provides outputs to the deliverables listed in the Table 1.

Provides outputs to:

Deliv. #	Deliverable title	How the two deliverables are related
D13.5	Exploitation and sustainability plan	D2.4 informs D13.5 about the training and certification approaches that will be developed during the project and how it may assist the development of a sustainable ASGARD community.
D13.6	Dissemination plan	D2.4 informs D13.5 about the training and certification approaches that will be developed during the project and could assist in the dissemination activities of the project.
D2.5	Open-source online base of training materials	D2.4 outlines key principles and approaches that will underpin the production of D2.5.

Table 1 – Relation to other deliverables – provides outputs to

1.3. Structure of the deliverable

This document includes the following sections:

- Section 1 provides an introduction to the report
- Section 2 discusses categories of ASGARD stakeholders and their associated training needs

- Section 3 discusses domain specific factors and limitations inherent in LEA specialist training and their impact on ASGARD training development.
- Section 4 puts forward principles and approaches that will be used in the development of ASGARD training and certification programmes that address issues raised in sections 2 and 3.
- Section 5 concludes the report.

2. Training needs of the stakeholders

The new technologies produced in ASGARD project will give raise to an ecosystem of stakeholders, which for the purposes of this document can be divided into the following categories:

- **LEA digital forensic experts and investigators.** This category represents the end users whose ultimate objective is investigation of specific incidents, collection and interpretation of digital evidence, and building criminal cases against specific individuals.
- **LEA intelligence analysts and planning officers.** This category comprises the end users collecting statistics and intelligence from multiple (potentially very large) sources of information of varying quality with the aim to inform LEA planning activities and proactive crime prevention operations.
- **Technology developers.** This category comprises the maintainers and developers of ASGARD software both during and after completion of the project. A sub-category of the technology developers are the end-users (LEA experts, investigators, analysts) with limited software development skills who are willing to contribute to ASGARD software.
- **System integrators and IT managers.** This category includes engineers and IT system managers concerned with the integration and maintenance of ASGARD technologies as part of LEA business process.
- **LEA managers.** This category consists of LEA managers who need to be informed about the capabilities offered by ASGARD technologies and the associated resource requirements.
- **Trainers**. This category includes anyone acting as an instructor in the delivery of ASGARD related training.

  The training requirements of these categories differ in the level and scope as summarised in the Table 2 below.

Stakeholder category	High-level training needs
Digital forensic experts and investigators	The training supporting this category of stakeholders should facilitate competent and efficient use of ASGARD tools in criminal investigations. In addition to teaching best practices and processes associated with specific tools, it should promote sufficiently deep understanding of the scientific principles underpinning the operation of the tools to enable students drawing valid conclusions from the output of individual tools and their ensembles. It should also promote

	the understanding of limitations inherent in specific tools and technologies as well as possible workarounds. This category of stakeholders may have to prove their proficiency in the court of law. Thus, the training should incorporate a formal examination process validating the proficiency of students to use ASGARD technology.
Technology developers	Given the open-source approach to software development adopted by the ASGARD project, it is essential that the new developers are quickly introduced to the essential project concepts and details. These are likely to be fluid and evolving with the software, and may include, for example, the overall system architecture, coding standards, main APIs and examples of their usage, protocols, query languages, etc. Historically, the end-users with limited software development skills (LEA investigators, experts, analysts) have been an important development resource in the field of digital forensics. They contributed many small tools that allowed the community to stay up-to-date with the rapid evolution of the information technology. In addition to the training needs summarised above, the amateur developers often need to learn fundamental software development skills and programming languages.
System integrators and IT managers	The training requirements for this category of stakeholders include skills and knowledge required to integrate ASGARD tools and technologies into pre-existing business processes and interface them with third-party systems and tools. Although there is a certain overlap with the training needs of technology developers, system integrators and IT managers will be concerned with the resource, maintenance, and life-cycle aspects of using ASGARD technology.
LEA managers	This category of stakeholders requires awareness training regarding the capabilities of ASGARD tools and the associated resource requirements to make informed strategic decisions about their adoption.
Trainers	As discussed in the following section, some trainers may have little or no experience in teaching, coaching or mentoring, in which case they would need to acquire necessary skills to be effective in this role.

Table 2 – High level training needs of different stakeholder categories

3. Domain specific factors affecting specialist training in LEA

Based on our past experience, it is important for LEA training developers to understand and take into account some of the factors and constraints inherent in the way LEAs operate: the highly specialized nature of high-tech crime investigations, the geographic localisation of most LEAs, and the resource limitations inherent in the public sector.

The specialised nature of high-tech crime work. The role of most LEAs is to maintain law and order in a particular locality / jurisdiction. As a result, the bulk of LEA workforce tend to be patrol officers, traffic corps, and other official roles that directly interact with the public. Digital forensic examiners, criminal intelligence

analysts, and resource planners comprise a *minority* within a LEA. They are highly-trained specialists working *individually* or in *teams* within the LEA tackling a particular type of crime and/or supporting other teams.

Localisation of LEAs. Although large capital cities can host several LEAs, many LEAs are geographically distributed. They are tied to a specific region or jurisdiction, and this geographic separation naturally *limits the interaction* of forensic experts and intelligence analysts with their peers in other agencies and localities. Furthermore, the geographic localisation of LEAs usually involves that LEA employees *do not have to speak multiple languages* to do their daily work, which limits their ability to interact with international partners. It also makes it harder for them to benefit from training courses delivered in a foreign language.

Resource limitations in the public sector. LEAs are public agencies funded by the exchequer. Due to the constant pressure to optimise the use of taxpayer money, LEA staff tends to be overloaded with casework and have little time for formal training courses at national or regional police academies. The limited budgets restrict the number of people who can travel to a course or conference in a single budget period, which further reduces the chances of an ordinary high-tech investigator or intelligence analyst attending a formal training course or international conference at a remote location.

As a consequence of the above factors, a significant amount (if not most) of specialist learning happens on the job, outside the traditional educational setting. It takes a variety of forms that includes mentoring by teammates and superiors, self-study using online resources, experimentation, reflective self-assessment of own work, and peer-assessment of own work by colleagues. Various closed and public online communication platforms and forums, such as DigitalDetective and Forensicfocus, help LEA professionals to overcome the distance factor and tap into the community expertise when the need arises. The language barrier still exists, but the online forums ameliorate this problem to a degree by providing access to the community members who know different languages and serve as a knowledge "bridge" between expert communities speaking different languages.

Given that a lot of specialist learning happens outside the traditional academic setting, ASGARD training and certification programme should support these forms of learning in addition to (or even instead!) the classroom based training in the traditional educational setting. Given the limited resources of the community members, ASGARD training and certification program should minimise the costs and effort involved in the development and maintenance of training materials and examinations, as wells as in the delivery of various forms of teaching and learning facilitated by these training materials and examinations.

4. Principles and approaches

4.1. Specification of learning outcomes

The current educational theory and practice is dominated by the idea that the curriculum and assessment development should be driven by the set of "learning outcomes", which are the skills and activities the student should be *able to perform* upon successful completion of the course. An appropriate assessment is considered an essential component of this approach, because – as pointed out by (Bloxham and Boyd, 2007) – "Students may take notes in lectures, seminars, or from their reading, they may have been through the prescribed activities in the laboratories or on the field trips, but it is only when faced with the assessment tasks that the majority seriously engage with the material." Although the "learning outcomes" approach had been criticised on the basis that not all learning can be specified and measured in terms of skills and activities (such as the learning of abstract conceptual knowledge), it is nonetheless useful in many contexts and especially in the context of professional training. As the ASGARD project evolves, the Task 2.4 will aim to define learning outcomes for potential trainings aimed at specific categories of stakeholders.

4.2. Maximal reuse of training materials

The traditional academic setting presumes that the learning occurs in the classroom environment, where most (or at least some) of the teaching is delivered using lectures. There are clear advantages to this style of teaching: lecture is an efficient way of communicating large amount of information from one instructor to many students; it gives the instructor an opportunity to convey his or her vision and conceptual understanding of a subject domain in a controlled fashion; most students are conditioned by the education system that lectures is the "normal" way of teaching. At the same time, the preparation and delivery of lectures requires substantial effort and skill on the part of the lecturer, it requires time commitment from students in addition to other learning tasks, it can be ineffective if the student is distracted or disinterested in the subject matter or lacks essential background knowledge.

Several prior initiatives aimed at the development training for LEAs targeted the traditional classroom model. The training materials of such courses would typically include

- Statement of learning outcomes
- Lessons plans
- Presentation slide decks
- Sample / recommended assessment activities
- Additional data and software that may have been created as educational exhibits or for assessment purposes

Although quite useful in the classroom setting, such training materials are rarely (if ever) are used without modifications. In particular, the lecturer may want to modify presentation slide decks and lessons plans to suite her or his style of lecturing, which may require substantial effort. The effort increases if the slide decks need to be translated into a foreign language. The presentation slide decks rarely contain the complete information about the subject, which makes them less useful for self-study or coaching purposes, unless they are accompanied by recordings of the actual lectures. At the same time, such training materials often contain highly reusable elements in the form of well-constructed examples, diagrams, intuitively plausible analogies, interactive activities, assessment tasks, etc. If designed well, such elements can be used in different learning settings with little or no modifications.

Rather than developing traditional classroom based training for ASGARD tools, Task 2.4 will focus on identifying existing (and developing new) highly reusable teaching aids, information sources, datasets, practical exercises, and assessment activities for ASGARD. It will then aim to define learning plans for different learning pathways making maximal use of the identified pre-existing and newly developed information sources and teaching aids. This will minimize the effort required to define and maintain ASGARD training now and going forward.

4.3. Assessment-driven learning

The education theory identifies several roles of assessment in learning, which can be summarised as

- the **assessment *of* learning**, which corresponds to the traditional (summative) view of assessment as a check that the learning has taken place and the student possesses the expected knowledge;
- the **assessment *for* learning**, which corresponds to the formative view of assessment as a practical activity on which the feedback is given with the aim to improve the student's performance;

- the **assessment *as* learning**, which corresponds to the problem-based teaching, where the learning occurs while the student is attempting to solve the posed assessment task.

There is a wide range of assessment methods and each method of assessment could be a better fit for each specific role. For example, the automated multiple-choice question tests provide an impartial check that the student possesses certain factual knowledge. The self-assessed individual projects, on the other hand, is a much better instrument for developing practical skills in a particular domain. The relatively straightforward mapping from learning outcomes (skills) to the assessment tasks allows the learning to be defined in terms of the assessment activities that need to be successfully completed. *Task 2.4 will employ this approach and use formative assessment activities (for learning and as learning) as the driver of the learning process. The learning plans will be built around assessment activities that represent the desired learning outcomes. This approach can be readily extended to the development of certification exams where the initial formative assessment serving as the course blueprint is complemented by the summative assessment validating the learning outcomes at the end of the course.*

4.4. Reliance on open source tools and processes

Given the limited resources of LEAs, it is important to try avoiding reliance on commercial products when designing and delivering training. There is a number of established open-source software products, such as LibreOffice and eXe Learning, which can be used for the production of ASGARD training. At the same time, it does not mean that essential proprietary services, such as Google Translate, should be avoided if no comparable open-source option exist.

Given the open source software development philosophy embraced by the ASGARD project, it makes sense to try and use an open source development model for the development and maintenance of ASGARD training and certification material. The intention is to select a project member (tool developer, end-user, or Stakeholder Advisory Group (SAG) member) to act as a maintainer & quality controller for each particular package of ASGARD training. The data comprising the training package will be stored in a GitLab repository, which can be cloned by other project participants. The contributions will be accepted in the form of pull requests, which will need to be reviewed and approved by the maintainer before inclusion into the main branch of the training package.

It is hoped that the maintenance will be ultimately driven by the end user community of ASGARD who will provide corrections, modifications, translations of the training packages into their native languages, and so on. It is likely that several branches of the main training package will emerge as a result of such activities.

5. Management of ASGARD certification programme

In order to ensure that the learning outcomes along with the associated assessment (including certification exams) and the base of training materials continue to exist and evolve beyond the lifetime of the project, the following measures will be taken:

- A small board of subject-matter experts (at most 10 people) will be established by the PMT for the purpose of curriculum and certification development. Provisionally, each member of the board will be responsible for the development of learning outcomes and associated assessment tasks (including certification examinations) for a particular aspect of ASGARD curriculum. The final decision about adopting a specific set of learning outcomes and assessment tasks will be done collegially by the entire board. The board will take into account relevant subject-specific curricula and education standards.
- Based on the identified learning outcomes and assessment tasks, the base of training materials will

be constructed making maximal use of the pre-existing training materials. To reduce costs, the training materials will be developed using open-source applications, such as OpenOffice, whenever possible and feasible.

- To host the developed course materials an online infrastructure will be established. This could consist, for example, of a course management system, such as Moodle, or a more development-focused online service, based around GitLab hosted initially at University College Dublin or another project partner.
- By analogy with SCUBA diving and Harley-Davidson clubs the project will strive to establish study groups in every police force in Europe. The idea is that police officers who passed ASGARD examinations will be authorized by ASGARD consortium to train their colleagues in preparation for the ASGARD certification and participate in the development of ASGARD training and examination. To build the initial momentum, ASGARD will rely on LEA partners and members of the SAG.
- A network of trusted testing centres will be required to administer ASGARD examination. The plan is to use premises and help of ASGARD consortium members initially, and then transfer it to SAG and the certification board upon completion of the project.
- ASGARD will adopt open-source software development model for further development and maintenance of ASGARD training and examination. Every member of ASGARD certification board will act as a maintainer & quality controller of a particular package of ASGARD training. The contributions from users will be accepted in the form of new sets of lectures / examination questions, which will need to be reviewed by the maintainer & approved by the board before inclusion into official annual ASGARD releases.

  It is expected that local study groups will produce translations into their native languages, which will have to be validated by several ASGARD community members speaking the same language before inclusion into ASGARD release. It is expected that each maintainer will nominate several sub-maintainers for that purpose.

6. Conclusion

6.1. Summary

In this document, we have discussed the principles and approaches that will be used for creation of ASGARD certification programme and associated training materials.

In section 1 we provided an introduction, described the relation of this deliverable to other deliverables and outlined the structure of this document

In section 2 we discussed different categories of stakeholders and their respective training needs.

In section 3 we presented some of the domain specific issues inherent in the law enforcement that will influence the development of training.

In section 4 we formulated guiding principles and approaches for the development of ASGARD certification programme and the associated training materials.

In section 5 we provide some concluding remarks and discuss future work.

In summary, we have put forward four key principles that will guide the evolution of ASGARD training and certification programme. These principles are as follows:

1. use of learning outcomes as the specification for certification and training development;
2. focus on the development of highly reusable teaching aids (and maximal reuse of pre-existing and newly developed information sources and training materials);
3. use of assessment activities as the driver of learning;
4. adoption of open source software and development processes to minimise costs.

6.2. Evaluation

The technological ideas put forward in this deliverable have been successfully tested in preparation for the first ASGARD hackathon. An initial open-source base of training material was prepared and used as a learning aid during the first ASGARD hackathon. A more detailed description of that development is given in the first draft of the deliverable D2.5.

6.3. Future work

The application of the principles and approaches presented in this report will guide the development of ASGARD certification programme and associated training and will be reflected in the future versions of the deliverable D2.5 that will evolve throughout the project.

ANNEX I. REFERENCES

The table below shows the most significant references used and/or cited to prepare this document:

Reference	Source
Bloxham and Boyd, 2007	Bloxham, Susan and Boyd, Pete, eds. (2007) *Developing effective assessment in higher education: a practical guide.* Open University Press.