cyberwatching.eu

The European watch on cybersecurity & privacy

Deliverable

Methodology for the Classification of Projects/Services and Market Readiness

December 2018

Disclaimer

The work described in this document has been conducted within the project cyberwatching.eu. This project has received funding from the European Union's Horizon 2020 (H2020) research and innovation programme under the Grant Agreement no 740129. This document does not represent the opinion of the European Union, and the European Union is not responsible for any use that might be made of its content.

Main Author: CONCEPTIVITY
Contributing Authors: Trust-IT Services, University of Oxford, AEI - The Cybersecurity Innovation Cluster of Spain, AON, ICT Legal Consulting

cyberwatching.eu consortium

Trust-IT Services
Communicating ICT to markets

Oxford e-Research Centre

University of Oxford

ICT Legal Consulting
Balboni Bolognini & Partners

European Digital SME Alliance

Conceptivity

360 Security

Aon

aeiciberseguridad

Third party

CITIC
Centro Andaluz de Innovación y Tecnologías de la Información y las Comunicaciones

Abstract:

This deliverable is the first in a series of publications over the duration of the cyberwatching.eu project, related with to methodology for the classification of projects/services and their Market Readiness. This document is focused on the description of the methodology for determining the TRL/MRL of a project and how these values will be used to build a classification matrix for the projects. Next documents will focus on the matrix itself, with data, and on the analysis of that matrix to elaborate a recommendations report on R&I needs.

Keywords *Market Readiness Level (MRL), Technology Readiness Level (TRL), Market and Technology Readiness Level (MTRL), Cybersecurity Taxonomy*

The work described in this document has been conducted within the project cyberwatching.eu. This project has received funding from the European Union's Horizon 2020 (H2020) research and innovation programme under the Grant Agreement no 740129. This document does not represent the opinion of the European Union, and the European Union is not responsible for any use that might be made of its content.

Executive Summary

Cyberwatching.eu is building the European observatory of research and innovation in the field of cybersecurity and privacy (CS&P), monitoring R&I initiatives throughout the European Union and Associated Countries and making it possible for stakeholders to increase their knowledge, raise their awareness and find possible synergies between different initiatives. One of the main assets is the catalogue of R&D projects in CS&P.

The aim of this deliverable is to establish the methodology for the classification of those projects regarding their market readiness to obtain a matrix of identified technologies and services, allowing to easily identify synergies and convergences among projects.

For this purpose, cyberwatching.eu is capitalising the results from CloudWATCH and CloudWATCH2[1] projects, by adapting the MTRL (Market and Technology Readiness Levels) methodology used in those projects to the topic of cybersecurity and privacy and the objectives of the cyberwatching.eu project.

To evaluate the closeness to the market of the projects, the MTRL methodology defines a pair of values (TRL, MRL), getting a score for both the Technology Readiness Level and the Market Readiness Level. In the scope of this task, we will simplify the 9 levels used in CloudWatch MTRL methodology to only 4 levels, for both TRL and MRL, which fits better with the goal of this task, as described along this document.

Another important difference between how the MTRL methodology is used in CloudWATCH2 and cyberwatching.eu comes in the way that projects are evaluated and assigned a score for the pair (TRL, MRL), since the first one count on a team of expert reviewers and the second one applies an automatic method from a questionnaire which is sent to the project representatives.

Once this pair is assigned for each project, the next step is to build a matrix that crosses the data from the results of the Technology Radar report (D2.2) with their MTRL values, so it is possible to see at a glance how many projects are in each of the three levels defined in L1 Taxonomy (D2.1), and which is their technology readiness and their closeness to the market.

Both the matrix and its analysis will leverage future R&I activities by the identification of low developed spaces or by establishing the starting point for future projects (to base the development in an existing product or service). This task, together with the Technology Radar Report, will allow us to identify clusters or projects working in the same sub-domain, with similar technology readiness and similar market readiness, which it will be definitively very useful in orienting the different initiatives of cyberwatching.eu to a specific group of projects. This will allow us to better focus the workshops, webinars and concertation meetings in order to establish mutually beneficial relationships among projects that can improve their technological or marketing capabilities through collaboration. It will also help in identifying common themes and challenges for clustering activities.

From an individual perspective, each project will have a better understanding of their own position on the current project landscape, and it will help to identify if the project results can be added to other assets of cyberwatching.eu such as the Marketplace[2] (T5.1) and End User Club[3] (T5.3).

This deliverable is the first in a series of documents addressing this objective of the cyberwatching.eu project. The next documents will focus on the matrix itself, with data,

[1] http://www.cloudwatchhub.eu/
[2] https://www.cyberwatching.eu/marketplace
[3] https://www.cyberwatching.eu/end-user-club

and on the analysis of that matrix to elaborate a recommendations report on R&I needs.

Terminology

AFRL	Air Force Research Laboratory
CRL	Commercialisation Readiness Level
EC	European Commission
EU	European Union
MRL	Market Readiness Level
MTRL	Market Technology Readiness Level
NASA	National Aeronautics and Space Administration
NYSERDA	New York State Energy Research and Development Authority
R&I	Research and Innovation
SERIOT	Secure and Safe Internet of Things
TRL	Technology Readiness Level

Table of Contents

1 Introduction 8

2 Clustering and Synergising in Cyberwatching.eu 9

3 Methodology 10

3.1 Market Readiness Measurement 10

3.1.1 Technology Readiness Levels (TRL) 11

3.1.2 Market Readiness Levels (MRL) 12

3.2 Projects Assessment Procedure: MTRL Cyberwatching.eu Tool 15

3.2.1 MTRL Cyberwatching.eu Tool – The Questionnaire 16

3.2.2 MTRL Cyberwatching.eu Tool – The Scoring 18

3.3 Matrix of identified technologies and services 21

4 Conclusion and Next Steps 25

LIST OF FIGURES

Figure 1. The interaction between WP within the cyberwatching.eu project 9
Figure 2. NASA Technology Readiness Levels 12
Figure 3. Design for the classification matrix of technologies and services 22
Figure 4. Visualization tool for the matrix of technologies and services 23
Figure 5. Synergy-Ignition Levers for cyberwatching.eu 25

LIST OF TABLES

Table 1. CloudWATCH2 Technology Readiness Levels 13
Table 2. Cyberwatching.eu Technology Readiness Levels 13
Table 3 CloudWATCH2 Market Readiness Levels 14
Table 4. Cyberwatching.eu Market Readiness Levels 15
Table 5. MTRL Questionnaire 18
Table 6. TRL Score 19
Table 7. Weight of the questions 20
Table 8. Response to the questionnaire (SERIOT project) 21
Table 9. Simplified scale for TRL and MRL 22

1 Introduction

Cyberwatching.eu aims to improve the impact of the results of Research and Innovation projects in the European Union and Associated Countries, and to achieve this, the overall cyberwatching.eu methodology is founded on the following 3 macro-activities: **1) Clustering & synergising; 2) Engaging; 3) Supporting**.

Each macro-activity, at operational level, translates effectively into a series of tasks, executed by means of a number of specific tools & levers.

Within the first macro-activity, **clustering & synergising**, the project is developing an effective way of clustering and monitoring R&I initiatives of cybersecurity and privacy in Europe, inducing collaborations and synergies. To this end, two previous tasks have been carried out at a first stage:

- Mapping & Clustering of R&I in EU & National and Associated Countries, carried out by the University of Oxford at European level and AEI-CITIC at National Level (Milestone 2.3).
- Establishing a Cybersecurity and Privacy Technology Radar, undertaken by the University of Oxford (Deliverable D2.2).

As the last step of this clustering & synergising process, it is necessary to characterise the projects, analyse their proximity to the market and build a "Matrix of identified technologies and services" considering their readiness level (M2.5 and M2.6). This will facilitate the connection between funded projects and future funding actions to find synergies and convergences and to take advantage of previous results to build new product and services on the founding blocks of the identified results.

This deliverable focuses on the description of the methodology **"Market & Technology Readiness Level" (MTRL)** used to evaluate how close to the market the projects are and how the "Matrix of identified technologies and services" will be built. The MTRL is introduced as a complementary methodology to "Technological Readiness Level" (TRL) to assess projects outcomes.

In adopting the MTRL methodology, cyberwatching.eu is being coherent with one of its main goals by re-using results from the CloudWATCH and CloudWATCH2 [4] projects, thus capitalising on the development of a clustering and concertation effort around European R&I in the Cloud Computing domain between 2013 and 2017[5]. Cyberwatching.eu will adapt the methodology to the topic of cybersecurity and privacy and the objectives of the cyberwatching.eu project.

After explaining the importance of clustering and synergising in Section 2, Section 3 focuses on describing the MTRL methodology, as defined in the CloudWATCH2 project, but adapted to Cyberwatching.eu ecosystem. Although the starting methodology is quite similar, the way in which the projects are evaluated is different. The "Matrix of identified technologies and services" will be built from the characterisation of projects and the scores of the projects (their market readiness) will be obtained from applying the MTRL methodology.

The deliverable ends with some conclusions and a description of the next tasks to be undertaken in Section 4.

[4] http://www.cloudwatchhub.eu/

[5] Trust-IT coordinates CloudWatch & CloudWatch2 and leads the concertation effort, while University of Oxford is responsible for the technical observatory.

2 Clustering and Synergising in Cyberwatching.eu

Within the cyberwatching.eu project the classifying of projects and market readiness is a fundamental step in the value chain that the project provides overall. As can be seen in Figure 1 the work of WP2 is the generation of information on projects at both national and pan European scope that are available to work with the cyberwatching.eu activity overall. The work package and hence activity feeds into the Concertation, Standards & Regulation, and Market & Sustainability WPs (WP3 and WP5, respectively). The Concertation activity is where we are aiming to bring together the community of projects in a manner which is beneficial to them and the EC so they better understand the landscape of cybersecurity and where they have placed projects within it. The WP5 is where project results are promoted through the Marketplace[6] (T5.1) and End User Club[7] (T5.3).

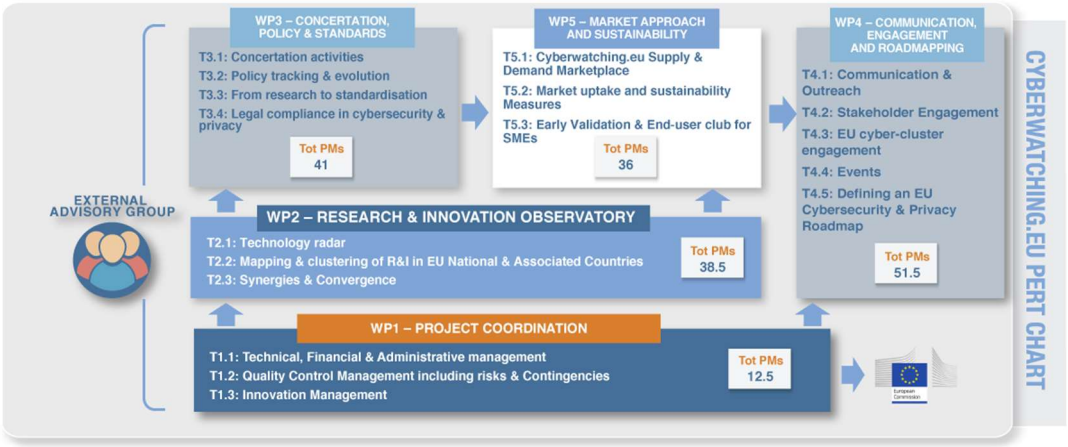

Figure 1. The interaction between WP within the cyberwatching.eu project

This deliverable belongs to task T2.3, the objective of which is to analyse the information generated in the previous tasks of WP2 to identify synergies and convergences among R&I initiatives.

By completing this task, cyberwatching.eu will close the first approach of the macro-activity “Clustering & synergising”, and will be able to identify:

- Future collaboration and sharing of experience on common technical priorities;
- Re-use of project results with components, technical ideas, methodologies or best practices identified by a repeatable statistical analysis;
- Identify market positioning and potential exploitation opportunities with other projects.

Based on the analysis and results from applying the methodology described in this document, cyberwatching.eu will hone in on priority areas and actively engage with clustered projects in a series of activities which incentivise and encourage projects to:

- Attend “Technology Deep Dive” workshops to map existing solutions with priority areas and enable common approaches to similar challenges and facilitate re-use of research results;
- Contribute to white-papers focussing on challenges in Cybersecurity & Privacy, to be also addressed by future Work Programmes;

[6] https://www.cyberwatching.eu/marketplace
[7] https://www.cyberwatching.eu/end-user-club

- Test and validate market readiness of R&I solutions.

Among the tasks that must be carried out to perform this analysis are the identification of the TRL/MRL of the different projects and the elaboration of a matrix that crosses the data of the projects outputs and their TRL/MRL. This document therefore defines the MTRL methodology used to identify the TRL/MRL of the funded initiatives and describes how the matrix of identified technologies and services will be designed.

The results of applying the MTRL methodology to projects is crucial for the Marketplace (WP5) which is a dynamic demand & supply reference hub bringing together cybersecurity & privacy providers of secure technologies. For a company, start-up, or any other institutions that are part of an EC-funded project that want to become a trusted provider and post their products, services or solutions on the Marketplace it is very important to know what the level of market readiness of their project is. Depending on that level, it can be offered as a ready-to-use product at the Marketplace or a product for validation or test at the End User Club (WP5).

The subsequent analysis of matrix of identified technologies and services is especially interesting for concertation activities[8] (WP3), whose objective is to take update stock of the current R&I landscape and to identify common themes and challenges for clustering activities.

3 Methodology

3.1 Market Readiness Measurement

One of the most used methods to measure the maturity of a technology is the Technology Readiness Level (TRL). This methodology, implemented by NASA[9] during the 1980s, was later formally defined and expanded for use in other industries. At its core, TRL is meant to objectively assess the maturity of a technology, starting at fundamental research and ending with an actual system proven in operational environment. It is widely used, including the European Commission Horizon 2020 (H2020) programme, the largest EU research and innovation program ever, with almost 80 million euros of funding available over 7 years.

However, by using exclusively this TRL classification, it is unlikely that Cyberwatching.eu could indeed confirm the readiness level of a product and/or service, since EC grants are given to projects to get to a TRL value based on the instruments.

Luckily there are many initiatives that complements its inherent shortcomings when it comes to describing how a technology would go from the commercial point of view. One of them is CloudWATCH2 project.

Just as technology must be prepared for entry into the market, support systems and processes, which are increasingly digital, must be implemented before a product can be sold or a successful service be offered, and customers must be ready, or enabled to be ready, to acquire and use technology. The gap between technology and preparation for the market must be saved with a better approach.

[8] https://www.cyberwatching.eu/concertation-meeting-brussels
[9] https://www.nasa.gov/directorates/heo/scan/engineering/technology/txt_accordion1.html

In the CloudWATCH2 project, this new approach was proposed[10] through the Market Readiness Level (MRL) of the outcomes of the cloud-based projects developed under the EU H2020 research program, alongside the Technical Readiness Levels.

This approach gives a complete vision of a project both from a technical and non-technical point of view. The score obtained by a project according to this methodology is called **MTRL Score** and it is a pair (TRL, MRL) that can be graphically presented to display the status of the project. This representation can be used both to assess the current situation of a project and to design a plan for the future of the project, that is, where we are and where we want to go. Although this approach was thought for the Cloud services domain, it can be also applied to Cybersecurity and Privacy domain, as both domains are mainly based on digital technologies, and software is the key component of all the related products and services.

The following sections briefly describe the concepts of TRL and MRL, as they have been used in the scope of this MTRL methodology. This will be the basic methodology that will be used for the assessment of projects in the cybersecurity and privacy field by cyberwatching.eu.

3.1.1 Technology Readiness Levels (TRL)

Technology Readiness Levels (TRL) are a type of measurement system used to assess the maturity level of a particular technology, initially defined by NASA. There are nine technology readiness levels, from TRL 1 being the lowest to TRL 9 that is the highest, as represented in Figure 3.

[10] https://www.cloudwatchhub.eu/sites/default/files/CloudWATCH_From_Project_To_Product.pdf

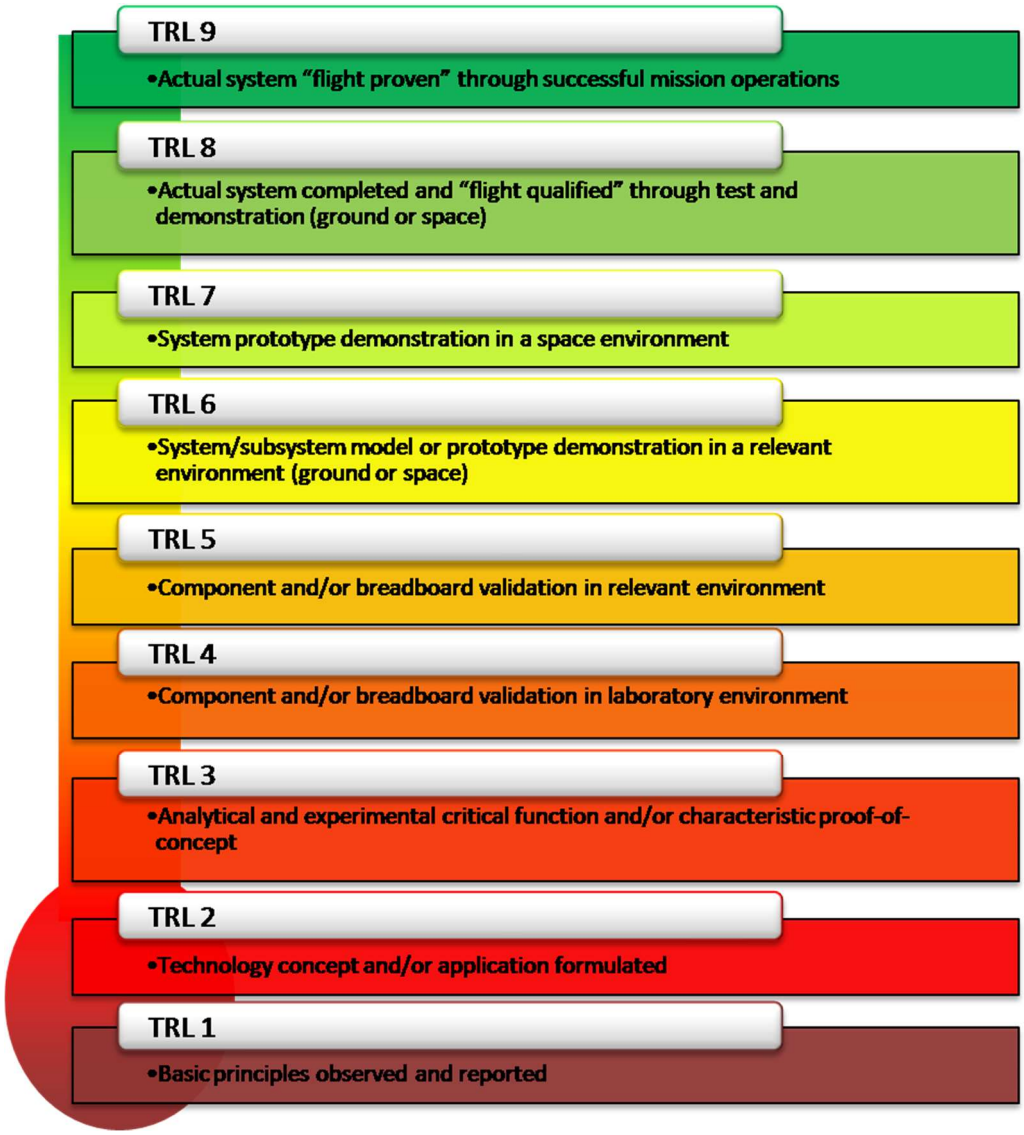

Figure 2. NASA Technology Readiness Levels

Using the NASA definition as a starting point, the European Commission (in the H2020 general annexes G[11]) provides the description of the TRL that applies for EC projects.

- TRL 1 – basic principles observed.
- TRL 2 – technology concept formulated.
- TRL 3 – experimental proof of concept.
- TRL 4 – technology validated in lab.
- TRL 5 – technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies).
- TRL 6 – technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies).
- TRL 7 – system prototype demonstration in operational environment.
- TRL 8 – system complete and qualified.
- TRL 9 – actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space).

As showed in Table 1, CloudWATCH2 added a new category "Phase" with several objectives: to simplify the TRL scale in order to keep a limited number of categories;

[11] https://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2018-2020/annexes/h2020-wp1820-annex-g-trl_en.pdf

to put more emphasis on and differentiate more between Research (TRL 0 – 3) and Innovation (TRL 4- 5); to recognise industry's need of mature technology which is easier and quicker to develop for market entry.

TRL	Description	Phase
0	**Idea**. Unproven concept, no testing has been performed.	Idea
1	**Basic Research.** Principles postulated and observed but no experimental proof available.	
2	**Technology formulation.** Concept and application have been formulated.	
3	**Applied research.** First laboratory test completed; proof of concept.	
4	**Small scale prototype.** Built in a laboratory environment (early prototype).	Prototype
5	**Large scale prototype.** Tested in intended environment.	
6	**Prototype system**. Tested in intended environment close to expected performance.	Validation
7	**Demonstration system.** Operating in operation environment at pre-commercial scale.	
8	**First of a king commercial system.** Manufacturing issues solved.	Production
9	**Full commercial application.** Technology generally available for all consumers.	

Table 1. CloudWATCH2 Technology Readiness Levels

In cyberwatching.eu we will use this TRL classification, as it applies to most of the Cybersecurity and Privacy R&D projects.

But in the scope of this task, we will be simplifying this classification using the name of the phase associated, as the goal of this methodology it is not a deep project analysis but finding synergies and convergences among them:

TRL	Phase
0-3	Idea
4-5	Prototype
6-7	Validation
8-9	Production

Table 2. Cyberwatching.eu Technology Readiness Levels

3.1.2 Market Readiness Levels (MRL)

As we already mentioned, although the TRL is a widely used and validated methodology to obtain the state of maturity of a technology, it has certain limitations, especially when determining the readiness for commercialization of that technology.

To bring the results of a project to the market, it is not enough to complete the technological developments, but rather a set of support activities is necessary. This support includes business strategy, business modelling, marketing, sales, after-sales support, etc. And this set of activities must be also measured to accurately determine the readiness level of a project outcome.

It is in this scenario where methodologies, such as Market Readiness Level (MRL), from CloudWATCH2, are applied to better assess the readiness level of a project result. MRL represents the work performed in the development of business process and administration, as TRL does for technical activities.

Starting from the concept of "business model" as the key mechanics of the product or service brought to market and applying their own "Four Fits Model"[12], CloudWATCH2 defined, as showed in Table 3, the MRLs for cloud-centric projects.

MRL	Description	Phase
0	**Hunch**. You perceive a need within a market and something ignites.	Ideation
1	**Basic Research.** You can now describe the need(s) but have no evidence.	
2	**Needs formulation.** You articulate the need(s) using a customer/user story.	
3	**Needs validation.** You have an initial "offering"; stakeholders like your slideware.	
4	**Small scale stakeholder campaign.** Run a campaign with stakeholders ("closed" beta – 50 friendly stakeholders).	Testing
5	**Large scale early adopter campaign.** Run a campaign with early adopters ("open" beta – 100 intended customers).	
6	**Proof of traction**. Sales match 100 paying customers.	Traction
7	**Proof of satisfaction.** A happy team and happy customers give evidence to progress.	
8	**Proof of scalability.** A stable sales pipeline and strong understanding of the market allow revenue projections.	Scaling
9	**Proof of stability.** KPIs surpassed and predictable growth.	

Table 3 CloudWATCH2 Market Readiness Levels

[12] https://www.cloudwatchhub.eu/exploitation/readiness-market-more-completing-software-development

MRLs inherit their scale form TRLs, matching the level of granularity. Similar to technical product development, MRLs feature four business process-oriented phases, from Ideation to Scaling business to a sustainable – and resilient – commercial operation.

These MRLs could be applied to Cybersecurity and Privacy project outcomes, since cloud services and cybersecurity and privacy services are intimately related, and as the use of cloud computing spreads so does awareness of the associated risks and the need to minimize the effects.

But in the scope of this task, we will be simplifying this classification using the name of the phase associated to a descriptive definition of how close to the market a project is:

MRL	Phase
0-3	**Ideation**: It seems almost impossible that the result/s can be introduced into the market successfully.
4-5	**Testing:** The project needs to improve some aspects of the preparation to market, but it's ready to join the End User Club for validating results.
6-7	**Traction:** The results are ready to be commercialized, but there is still room for enhancement and some aspects should be improved.
8-9	**Scaling:** The sales are going well and the product/service is stable.

Table 4. Cyberwatching.eu Market Readiness Levels

3.2 Projects Assessment Procedure: MTRL Cyberwatching.eu Tool

As defined in Section 3.1, the evaluation of a project according to the MTRL methodology is a pair (TRL, MRL). And here is where we find the main differences between CloudWatch2 methodology and Cyberwatching.eu methodology.

CloudWATCH2 project applied the following procedure to obtain these values:

1. **Form a team of reviewers**: an expert in business modelling and business development; an expert in marketing and sales; and an expert in technology and innovation.
2. **Request for information**, to gather initial information from projects in consistent form. This is made via a Google Form that asks for high-level details of the project.
3. **Independent research**, to get a deep understanding of the project and its landscape and context. All reviewers undertook independent research on each project, but under a common working method (review documentation, website and provided links). Beyond this, reviewers were free in their choice of methodology and encouraged to apply further individual research.
4. **Reviewer workshop**, where reviewers share information and discuss recommendations. Once all reviewers indicated that they concluded their individual research, the team conducted an internal workshop. At the end of the workshop, the team converged onto a scoring (TRL, MRL) and recommendations for each project.
5. **Delivering the review**, that is, a joint workshop with the project representatives where the scores and related recommendations are presented.

But the baseline scenario of cyberwatching.eu project differs from the CloudWATCH2 project, mainly in three points:

1. There is no team of expert reviewers, as part of the project, to perform this task.
2. The number of projects to be evaluated is very high (more than 100 just to start and it will grow as the projects catalogue grows).

3. The main goal of the assessment is not the deep understanding of the project but the identification of synergies and convergences.

Under these premises, **cyberwatching.eu proposes the use of a tool that allows to obtain the MTRL (TRL, MRL) score automatically**.

This idea is not new, in fact the AFRL (Air Force Research Laboratory) has developed a TRL Calculator[13] which is a tool for assessing TRLs in technology development programs. In its present form, the calculator is a Microsoft Excel spreadsheet application[14] that allows the user to answer a set of questions about a technology project, and shows a score as a result.

NYSERDA (New York State Energy Research and Development Authority) goes one step further with its NYSERDA TRL Calculator[15], an Excel workbook to determine not only the level of technical maturity, but also the commercial maturity (similar to MRL) of a product/service.

The use of an automatic evaluation method provides certain advantages that perfectly fits with the scenario of the cyberwatching.eu project, such as:

1. It is easier to reach and evaluate a larger number of projects.
2. It provides a standardized, repeatable process for evaluating the project under analysis.
3. It quickly provides a snapshot of the status of a project at a given time.

This MTRL cyberwatching.eu tool will be sent to a representative of each project, with some recommendations regarding the need to be honest with the answers. It can be seen as an auto-evaluation tool to assess the current state of the project, and depending on the score, the project outcomes can be added to the Marketplace or the End User Club. It can also help in identifying the project weaknesses and next steps. But if the project representative fakes their answers, the project itself will be the main harmed, as it will generate wrong expectations and the potential buyers or testers will be disappointed, not willing to have more interactions with those partners. On the other hand, when using this kind of tool, the given score is based only in objective criteria, not being contrasted with the subjective opinion of a team of expert reviewers and, therefore, this provided result should be taken only informatively, so the project representative will be advised not to take any action without having previously consulted with a professional advisor.

The MTRL cyberwatching.eu Tool will be an adaptation to cyberwatching.eu project from the NYSERDA TRL Calculator. In the following sections, we describe the questionnaire that will be used for implementing the MTRL tool and how the scores will be calculated from the answers to get the pair (TRL, MRL).

3.2.1 MTRL Cyberwatching.eu Tool – The Questionnaire

The NYSERDA TRL Calculator is defined to help emerging and growing companies determine the level of technical and commercial maturity of their products/innovations through the calculation of the Technology Readiness Level (TRL) and the Commercialisation Readiness Level (CRL). It consists of 7 questions regarding Technology, Product Development, Product Definition / Design, Competitive Landscape, Team, Go-To-Market and Manufacturing / Supply Chain.

The questionnaire of the **MTRL cyberwatching.eu Tool** slightly modifies these questions and adds two more questions related to crucial issues when dealing with R&D projects: Documentation and Intellectual Property Management (so there are 9

[13] https://ndiastorage.blob.core.usgovcloudapi.net/ndia/2003/systems/nolte2.pdf
[14] http://aries.ucsd.edu/ARIES/MEETINGS/0712/Waganer/TRL%20Calc%20Ver%202_2.xls
[15] http://files.masscec.com/innovate-clean-energy/NYSERDA-TRLCalculator.xlsm

questions in total). The first two questions are focused on obtaining a value for the TRL and the rest for the MRL. For each question, 5 possible answers are shown, ordered from less developed (answer number 1) to more developed (answer number 5). The project representative should select the answer that best fits their project.

Table 5 shows the content of the questionnaire (it will also include an introduction and the instructions to fill it). The first sub table gathers general information about the project to be evaluated, and the others conform the questionnaire itself.

GENERAL INFORMATION	
Project name	Acronym and full name of the project
Website	The project's website
Full name	The name of the contact person for the project
Email	The contact email address
Project outcomes	A brief description of the expected results of the project, i.e. products, services, components, etc.
Authorization	(A checklist for the user to give permission about certain issues, for example: to publish the results, etc.)
1. PROJECT MATURITY	
1. Project work is beyond basic research and technology concept has been defined 2. Applied research has begun and practical applications have been identified 3. Preliminary testing of technology components has begun in a laboratory environment 4. Initial testing of integrated product has been completed in an operational environment 5. Integrated product demonstrates performance in the intended applications	
2. PRODUCT DEVELOPMENT	
1. Initial product/market fit has been defined 2. Pilot scale product has been tested in the intended application 3. Demonstration of a full scale product prototype has been completed in the intended application 4. Actual product has been proven to work in its near-final form under a representative set of expected conditions and environments 5. Product is in final format and has been operated under the full range of operating conditions and environments	
3. PRODUCT DEFINITION/DESIGN	
1. One or more initial product hypotheses have been defined 2. Mapping product attributes against customer needs has highlighted a clear value proposition 3. The product has been scaled from laboratory to pilot scale and issues that may affect achieving full scale have been identified 4. Comprehensive customer value proposition model has been developed, including a detailed understanding of product design specifications, required certifications, and trade-offs 5. Product final design optimization has been completed, required certifications have been obtained and product has incorporated detailed customer and product requirements	
4. COMPETITIVE LANDSCAPE	
1. Market research has been performed and basic knowledge of potential applications and competitive landscape have been identified 2. Primary market research to prove the product commercial feasibility has been completed and basic understanding of competitive products has been demonstrated 3. Comprehensive market research to prove the product commercial feasibility has been completed and intermediate understanding of competitive products has been demonstrated 4. Competitive analysis to illustrate unique features and advantages of the product compared to competitive products has been completed 5. Full and complete understanding of the competitive landscape, target applications, competitive products and market has been achieved	

5. TEAM
1. No team or organization (single individual, no legal entity) 2. Solely technical or non-technical founders running the organization with no outside assistance 3. Solely technical or non-technical founders running the organization with assistance from outside (advisors, mentors, incubator, accelerator, etc.) 4. Balanced team with technical and business experience running the organization 5. Balanced team with all capabilities on-board (sales, marketing, customer service, operations, etc.) running the organization
6. DOCUMENTATION
1. Solely technical descriptions have been elaborated, i.e., software documentation, architecture diagrams, etc. 2. User-oriented documentation has been created, such as user manual, installation guides, reference manual, etc. 3. Live demonstration resources have been developed (recorded videos, website with link to demo, etc.) 4. Position papers, press releases, posters, etc. have been elaborated for the dissemination of the project 5. Marketing documentation has been created, such as a Business Model Canvas, etc.
7. INTELLECTUAL PROPERTY MANAGEMENT
1. No IPR have been defined 2. Initial means of protection have been considered 3. A proper and clear definition of shares has been elaborated 4. An assignation of exploitation rights has been developed 5. A contractual obligation regarding IPR has been established
8. GO-TO-MARKET
1. Initial business model and value proposition have been defined 2. Customers have been interviewed to understand their needs and business model and value proposition have been redefined based on customer feedback 3. Market and customer needs and how those translate to product requirements have been defined, and initial relationships have been developed with key stakeholders across the value chain 4. Partnerships have been formed with key stakeholders across the value chain (suppliers, partners, service providers, customers) 5. Supply agreements with suppliers and partners are in place and initial purchase orders from customers have been received
9. MANUFACTURING/SUPPLY CHAIN
1. Potential suppliers, partners and customers have been identified and mapped in an initial value chain analysis 2. Relationships have been established with potential suppliers, partners, service providers and customers and the have provided input on product and manufacturability requirements 3. Manufacturing process qualifications have been defined and are in progress 4. Products have been pilot manufactured and sold to initial customers 5. Full scale manufacturing and widespread deployment of product to customers has been achieved

Table 5. MTRL Questionnaire

This questionnaire will be implemented through a webform on the cyberwatching.eu website with results displayed in a downloadable Excel spreadsheet that facilitates the task of obtain a score automatically from the answers. The following section details how the TRL and MRL values will be calculated from the users' replies.

3.2.2 MTRL Cyberwatching.eu Tool – The Scoring

As described in the previous section, there are two sets of questions, one focused to obtain the TRL (the first two questions) and the other to obtain the MRL (the rest of questions).

To obtain the TRL score, MTRL cyberwatching.eu tool uses the same criteria than NYSERDA tool: the value selected for PROJECT MATURITY determines the TRL between levels 1 – 5 and the value selected for PRODUCT DEVELOPMENT determines the TRL between levels 6 – 9. To be more specific:

- When the value of PRODUCT DEVELOPMENT is between 2 and 5, the TRL value is obtained proportionally to this value, regardless of the value of PROJECT MATURITY.
- When PRODUCT DEVELOPMENT is 1, the value of PROJECT MATURITY coincides with the TRL value.

Table 6 shows how the scores are obtained from these two questions.

1. PROJECT MATURITY	2. PRODUCT DEVELOPMENT	TRL
-	5	9
-	4	8
-	3	7
-	2	6
5	1	5
4	1	4
3	1	3
2	1	2
1	1	1

Table 6. TRL Score

To explain this by a mathematical expression, let q_1 be the value selected for the PROJECT MATURITY question and q_2 the value selected for the PRODUCT DEVELOPMENT question, then the final TRL score would be calculated using the expression:

$$TRLscore = \begin{cases} q_2 + 4, & (q_2 \geq 2) \\ q_1, & otherwise \end{cases}$$

To get the MRL score, MTRL cyberwatching.eu tool follows a different approach. Each question is assigned a weight, so that the response selected by the user is weighted according to that weight. To establish the weight for each question, cyberwatching.eu assumes the following considerations:

- **Team**: There is no doubt about the fact that the human asset is the key intangible asset for any organization. So a well-organized group of people can lead a project to success.
- **Manufacturing/Supply chain**: Having a well-oiled sales mechanism will pave the entry of any product/service into the market. Start to commercialise a product without previous experience is not an easy task.
- **Go to Market**: Business models enable an organization to create value out of new ideas. Simply having a good product or service is not enough without the answers to some key questions about how to take it forward.
- **Product Definition / Design**: A good business model needs to be complemented by a well-defined product/service from the beginning, adapted to the end user needs. If not, an organization can make good sales when first launching the product, but afterwards the brand name can be affected by the bad opinions about the product/service.

- **Competitive landscape**: With all the previous issues covered, success seems quite probable. But there is still a weak point that can affect the sales: the unknowledge of the market to be sure that the product/service satisfied a need better than the competitors.
- **Documentation**: Specifically for R&D projects, highly innovative, thatincludes new technologies or new ways to apply technologies, there is a need of write down each step in every stage of the product/service development, from design to commercialization, because innovation means new ways of doing things, and everything must be highly detailed.
- **Intellectual Property Management**: Even if Intellectual Property is one of the most important assets of a leading-edge technology organization, it requires to balance the cost involved in registering IP against the protection that will be required in markets they are in or plan to develop.

Table 7 shows the weights assigned to each question in the scope of the cyberwatching.eu project.

QUESTION	WEIGHT
3. PRODUCT DEFINITION/DESIGN	4
4. COMPETITIVE LANDSCAPE	3
5. TEAM	7
6. DOCUMENTATION	2
7. INTELLECTUAL PROPERTY MANAGEMENT	1
8. GO-TO-MARKET	5
9. MANUFACTURING/SUPPLY CHAIN	6

Table 7. Weight of the questions

To explain this by a mathematical expression, let q_i be the value of the answer to question i and w_i the weight of that question (for i from 3 to 9), then the score obtained according to the questionnaire would be $\Sigma(q_i \cdot w_i)$. Given that 5 is the highest possible value for each answer, the maximum value that could be obtained according to this questionnaire would be $5 \cdot \Sigma w_i$. Since what is intended is to obtain a value within the scale defined for MRLs, which has 9 values, the final MRL score would be calculated using the expression:

$$MRLscore = \frac{9 \times \Sigma(q_i \times w_i)}{5 \times \Sigma w_i}$$

To better understand the exposed above, let's calculate the pair (TRL, MRL) for a real project included in the Cyberwatching.eu Observatory, the SERIOT[16] project.

We sent the questionnaire to a project representative, who provided the answers shown in Table 8.

1. PROJECT MATURITY
2. Applied research has begun and practical applications have been identified
2. PRODUCT DEVELOPMENT
1. Initial product/market fit has been defined
3. PRODUCT DEFINITION/DESIGN
1. One or more initial product hypotheses have been defined

[16] https://www.cyberwatching.eu/projects/981/seriot

4. COMPETITIVE LANDSCAPE
1. Market research has been performed and basic knowledge of potential applications and competitive landscape have been identified
5. TEAM
1. No team or organization (single individual, no legal entity)
6. DOCUMENTATION
1. Solely technical descriptions have been elaborated, i.e., software documentation, architecture diagrams, etc.
7. INTELLECTUAL PROPERTY MANAGEMENT
1. No IPR have been defined
8. GO-TO-MARKET
1. Initial business model and value proposition have been defined
9. MANUFACTURING/SUPPLY CHAIN
1. Potential suppliers, partners and customers have been identified and mapped in an initial value chain analysis

Table 8. Response to the questionnaire (SERIOT project)

After applying the formulas for TRL and MRL using the weights of Table 7, its score would be:

- $TRL = 2$
- $MRL = \frac{9\times[(1\times4)+(1\times3)+(1\times7)+(1\times2)+(1\times1)+(1\times5)+(1\times6)]}{5\times(4+3+7+2+1+5+6)} = \frac{9\times28}{140} = 1.8$

Rounding down values, the score (TRL, MRL) is (2, 1).

In the following section, it is shown what to do with this values.

3.3 Matrix of identified technologies and services

The main objective of the task to which this deliverable is associated is to facilitate the connection between funded projects and future funding actions to find synergies and convergences, so it will be possible to take advantage of previous results to build new products and services on the founding blocks of the identified results.

The method to identify these synergies and convergences will be:

1. **Characterisation of the projects**: Based on the task 2.1, *CS&P Technology Radar*, which implements a project grouping applying cyberwatching.eu taxonomy (D2.1), a description or listing of the projects outputs shall be developed.
2. **Analysis and identification of the "Market Readiness Level" of the different projects**: This is the result of applying the MTRL methodology, described in the previous sections, to the different projects.
3. **Matrix of identified technologies and services**: This is the result of crossing the data obtained in the two previous steps.

As a result of these tasks, not only the matrix of identified technologies and services will be obtained, but also an analysis of that matrix. This section focuses on describing how this matrix is going to be built, in order to make the required analysis.

As the matrix results will be represented in a visually attractive way, in the scope of this task it may be a good idea to rename these categories or phases with significant names (Table 9):

- For the TRL, the groups defined for the Technology Radar will be used. Since this matrix must be aligned with the results obtained in the Technology Radar report it makes sense to use the same nomenclature, with one exceptions – "hold" and "drop" will be joined in a unified category under "Legacy".
- For the MRL, each of the categories can be renamed in a way that reflects the level of preparation of the project to go to market.

TRL / Technology Radar	MRL / Preparation level
Idea / Assess	Ideation / Insufficiently prepared
Prototype / Trial	Testing / Poorly prepared
Validation / Adopt	Traction / Fairly prepared
Production / Legacy	Scaling / Greatly prepared

Table 9. Simplified scale for TRL and MRL

Finally, once the groups are defined, the matrix will be constructed as an Excel file following the structure shown in

Figure 3. This Excel will contain a list of all the projects that are being evaluated and the sub-domain to which it belongs (the sub-domain ranked first in the Cyberwatching.eu Taxonomy L1 classification). In the next columns the defined categories for the TRL are shown (Assess, Trial, Adopt, Legacy). Each project can only appear in one of the four columns. In the corresponding cell, the MRL level of that project is shown. Each level of MRL is assigned a colour, which makes it easier to get an overview.

Insufficiently prepared	Ideation: It seems almost impossible that the result/s can be introduced into the market successfully.
Poorly prepared	Testing: The project needs to improve some aspects of the preparation to market, but it's ready to join the End User Club for validating
Fairly prepared	Traction: The results are ready to be commercialized, but there is still room for enhancement and some aspects should be improved.
Greatly prepared	Scaling: The sales are going well and the product/service is stable.

Project	Taxonomy L1	Assess	Trial	Adopt	Legacy
Project 1	Found. of tech & risk management				Insufficiently prepared
Project 2	Apps & user oriented services			Fairly prepared	
Project 3	Found. of tech & risk management	Poorly prepared			
Project 4	Governance, Ethics, Trust		Fairly prepared		
Project 5	Apps & user oriented services			Greatly prepared	
Project 6	Found. of tech & risk management	Insufficiently prepared			
Project 7	Governance, Ethics, Trust		Greatly prepared		
Project 8	Governance, Ethics, Trust		Fairly prepared		
Project 9	Governance, Ethics, Trust			Greatly prepared	
Project 10	Found. of tech & risk management		Poorly prepared		

Figure 3. Design for the classification matrix of technologies and services

Once the matrix is filled with the data from the projects, an analysis of the information collected will be carried out by implementing a visualization tool which allows to see at a glance the status of the projects for each of the taxonomy L1 options, using a graphic representation similar to the one used in the Technology radar. Using the information of the example in

Figure 3 the visualization tool will be as shown in Figure 4.

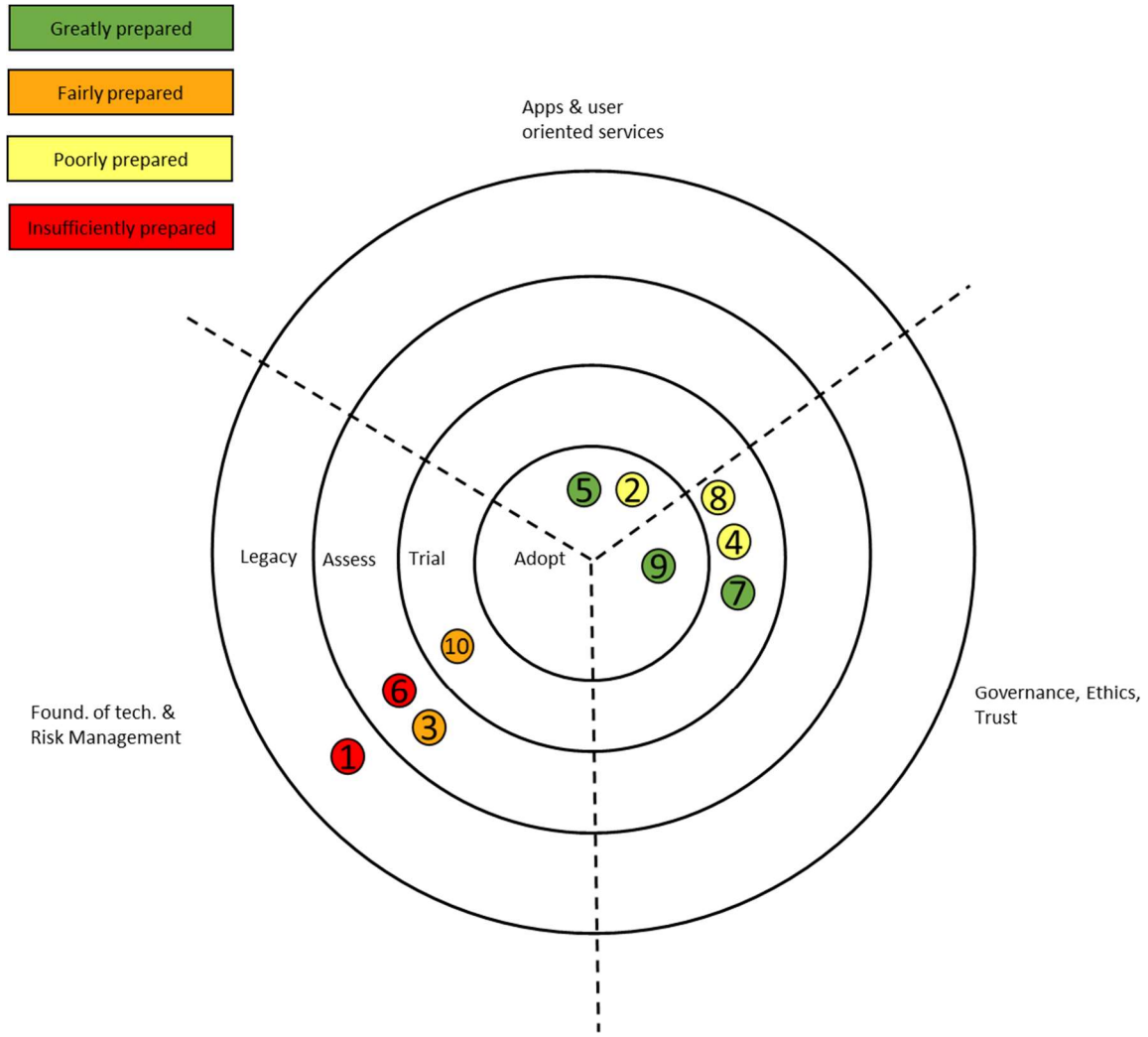

Figure 4. Visualization tool for the matrix of technologies and services

A first use of this visualization tool is the possibility to compare the status self-evaluation carried out automatically by the projects representatives using the questionnaire with the manual assessments of projects performed in D2.2 to determine how accurate it is. This tool will help to determine which sub-domains from L1 taxonomy are less mature, both in the technology readiness and the closeness to the market. This will also permit to identify which projects could collaborate to improve their technological or marketing capabilities, and therefore will allow to better focus the cluster oriented activities.

Besides, both the matrix and its analysis will leverage future R&I activities by:

- **Identification of low developed spaces:** proposals and / or priorities could be proposed to cover those lower developed spaces of the mesh, and after having crossed those spaces with the SRIA (Security Research and Innovation Agenda). SRIA provides the industry with a detailed set of technical (and non-technical) priorities and needs to be developed.
- **Establishing the starting point for future projects:** the matrix and its analysis will pave the way to establish a “reference guide” from which organizations will be able to start their developments without investing time and resources in an existing product or service.
- **Establishing and continuously updating an online catalogue of R&I services of projects and generated knowledge**: organisations will be able to

identify who has made what, when, where, as well as the way to contact them. This will foster knowledge transfer and collaboration among stakeholders.

This analysis will be complemented with the synergy-ignition levers. The **synergy-ignition levers** are a set of sub-tasks that will be carried out, as part of the cyberwatching.eu project, to ensure a pragmatic and structured approach to synergy creation. These tasks are (Figure 4):

- Mutual presentation of achieved results. In this task fits the Concertation Meetings, which are held once a year. The next Concertation Meeting is planned for spring 2019 (last edition was held in Brussels, April 2018[17]). The objective of these Concertation Meetings is to take stock of the current R&I landscape and to identify common themes and challenges for clustering activities. It will also be used to promote success stories derived from the analysis performed.
- Preparation of the necessary facilitating legal paperwork for initiatives to mutually disclose information and pragmatically build upon each-others achieved results (e.g., NDAs, MOUs);
- Continuous Partner matchmaking activity for R&I projects, on the basis of specific competences that are requested;
- Continuous matchmaking activity with R&I funding opportunities at European and National level;
- Representation of current marketplace opportunities (buyers vs providers). In this task fits the Marketplace and the End User Club. Both of them are services offered by the cyberwatching.eu project for CS&P organizations. MTRL scores can help projects to better understand where they sit and this must be taken into account for the End User and validator club.
- Assistance of mediation to one-on-one and one-on many meetings for collaboration, both from the scientific and the business opportunity preparation point of view.

Once a first version of the analysis is performed, several Technology Deep Dive workshops will be organized for each cluster of R&I activities so the representatives can meet both physically and virtually. These workshops will enable the different projects to meet and determine synergies among them, what is the impact of the investment made, as well as build broad pictures of the different markets.

Synergies will also be sought through the different webinars that are being organized during the project. The objective of these webinars is to reach and educate wide audiences with useful tips, user experiences and expert insights as part of the cyberwatching.eu creation of a cyber-security culture. The analysis to be performed in this task will detect those areas that have more difficulties to bring their products to the market, as well as the challenges they face, which will allow designing specific webinars to tackle these difficulties, helping projects to advance in the development of their products.

But this analysis is also very interesting for the projects themselves, since they will have a better understanding of their position on the current project landscape. This information can be very useful in order to offer their products in the Marketplace as well as for the End User and validator club.

[17] https://www.cyberwatching.eu/concertation-meeting-brussels

Figure 5. Synergy-Ignition Levers for cyberwatching.eu

4 Conclusion and Next Steps

As explained in previous sections, the objective of applying the methodology described in this deliverable is to build the classification “Matrix of identified technologies and services” and perform an analysis of that matrix to detect "synergies and convergences".

It is important to keep in mind why all this is done: What is the advantage of using the MTRL methodology? What is the purpose of the classification matrix?

Regarding the first question, the MTRL methodology and the proposed questionnaire can be used as a self-assessment tool, allowing project representatives to quantify the current state of the project under study. If the desired state of the project is known, this methodology allows to trace a trajectory from the current state to the target state that is a key element of project management and business change management. Besides the score as a global marker, the answers to each of the sections of the questionnaire can help the project’s manager to detect which are the weak points, so that they can identify the areas that allow a better improvement in the score with the least effort.

Regarding the second question, the classification of the projects using the values provided by the MTRL methodology can serve as a first step to evaluate the accuracy of the manual classification made in the technology radar (D2.2). But the main objective of this analysis is to leverage future R&I activities as explained in section 3.3. By deeply analysing the matrix results, it will be easy to identify which cybersecurity sub-domains are more advanced both in the technological and marketing sense, and which specific projects are leading each category. And this a very valuable information for projects whatever its status is.

To build the matrix, two fundamental data blocks are needed: the results from the Technology Radar report, which is included in the deliverable 2.2, and the classification of the projects according to their technology and market readiness.

The next steps are precisely focused on obtaining this second block of data:

1. All the projects registered in the cyberwatching.eu Service Catalogue[18] will be contacted via email, requesting them to complete the questionnaire. It is important to make clear in the email that this questionnaire is a self-assessment tool, which will serve to stablish the current state of the project and, in this way, be able to take the necessary measures to reach the desired target level. This self-evaluation will also serve as a reinforcement of the projects/products for the marketplace and end user club, identifying those that are already in position to be evaluated or even used by other organizations or projects. For these reasons it makes no sense to fake the answers. **The first email campaign will be carried out during the M21.**
2. As answers from this questionnaire are being collected, the classification matrix will be updated. **The first version of the matrix with the results will be published in M24**, with the answers provided to date.
3. After analysing the matrix, projects identified with a TRL in "Trial" in Trial and MRL in "Testing" will be contacted to evaluate the chance to join the End User Club. Projects identified with a TRL in "Adopt" and MRL in "Traction" will be contacted to evaluate the chance to join the Marketplace.
4. For those projects that have not answered, **a reminder message will be sent during the M24**.
5. The results of the analysis of the first version of the matrix will be presented in an open webinar focused on the gaps identified. This **webinar will be scheduled for M24**.
6. At the time of writing this deliverable there are 48 registered projects in the cyberwatching.eu Service Catalogue, but since the registration process is active throughout the project, the questionnaire will also be sent to all newly funded projects in EC Unit H1 Cybersecurity and Privacy as they are registered. **New mailing campaigns with the questionnaires will be made as new projects are registered during the life of the project.**
7. **The matrix will be updated as new responses from the projects are obtained**.

The analysis of the data of this matrix can also be interesting for the **Concertation Meeting** that is planned for Spring 2019 where several projects meet to share their experiences. Events like this are a perfect meeting point so that projects with higher MRL levels can tell their experience and also serve as reference to others who are trying to reach that same point. From the grouping performed in D2.2 and the analysis performed through the Matrix of identified technologies and services, cyberwatching.eu partners will be prepared to link the proper projects in these meetings, so that they can take advantages one from the other.

As mentioned above, this task is active throughout the project, so the classification matrix will be progressively updated. This can cause the results and the analysis to evolve and change over time. New webinars can be organized if new needs or interesting results to share are detected. Both the matrix with all the data and its analysis will be explained in detail in D2.8 (M48).

www.cyberwatching.eu

@cyberwatchingeu

/in/cyber-watching/

cyberwatching.eu has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 740129.