



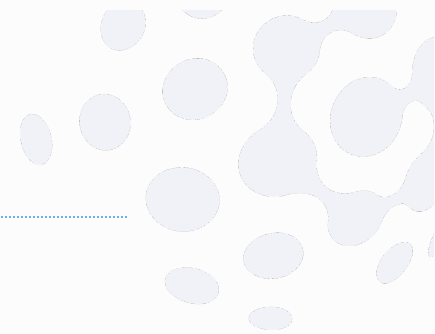
Deliverable D3.1

Node mapping to TRLs

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Log of changes

Date	Mvm	Who	Description
29/03/2023	0v1	Kjell Petersen (UiB), Eivind Hovig (UiO)	Initial version
31/03/2023	0v2	Kjell Petersen (UiB), Eivind Hovig (UiO)	Revised content, added discussion and conclusion
11/04/2023	0v3	Eivind Hovig (UiO), Kjell Petersen (UiB)	Completed draft
19/04/2023	0v4	Eivind Hovig (UiO), Kjell Petersen (UiB)	Revised and finalised the suggested report, adopting the input from reviewers
25/04/2023	0v5	Eivind Hovig (UiO), Kjell Petersen (UiB)	Final edits from Management Board review input.

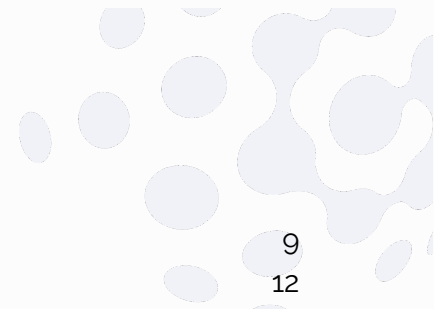
Table of contents

Contents

1. Executive Summary	3
2. Contribution towards project outcomes	4
3. Methods	6
4. Description of work accomplished	6
4.1 Introduction to data collected	6
4.2 Summary of Node mapping to TRL	8
4.2.1 TRL evaluation per node	9
4.3 Individual Node mapping results including justification comments	9



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4.3.1 Vanguard nodes	9
4.3.2 Remaining nodes (that have answered)	12
5. Results and discussion	15
6. Conclusions & Impact	15
7. Next steps	16

1. Executive Summary

The main deliverable scope was to map the Technical Readiness Levels (TRLs) of the participating GDI nodes. The nodes perform self-reporting for the purpose of establishing the operational readiness-level. In order to achieve this, the technical aspects from the overall readiness tool were used for this deliverable. After 3 months in the project, the tool has been applied for the first time. Not all nodes were able to complete the self-reporting in time. The vanguard nodes were in general further along than the other nodes, but none of the nodes had achieved all of the technical prerequisites to progress from "onboarding" into the "deployment" phase. It is expected that this will change at the M08 milestone, where a minimum of 5 nodes are to have the five core functionalities established. Continuous progress monitoring and follow-up will be important to lay the ground for more consistent and representative progress reporting in the coming phases of the project.



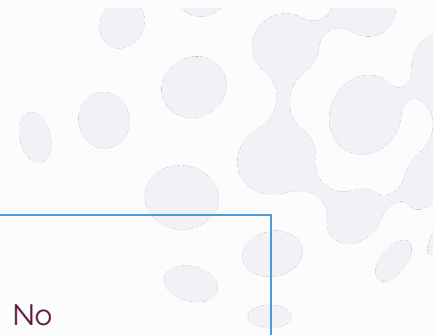


2. Contribution towards project outcomes

With this deliverable, the project has reached or the deliverable has contributed to the following project outcomes:

	Contributed
<p>Outcome 1</p> <p>Secure federated infrastructure and data governance needed to enable sustainable and secure cross border linkage of genomic data sets in compliance with the relevant and agreed legal, ethical, quality and interoperability requirements and standards based on the progress achieved by the 1+MG initiative.</p>	Yes
<p>Outcome 2</p> <p>Platform performing distributed analysis of genetic/genomic data and any linked clinical/phenotypic information; it should be based on the principle of federated access to data sources, include a federated/multi party authorisation and authentication system, and enable application of appropriate secure multi-party and/or high-end computing, AI and simulation techniques and resources.</p>	No
<p>Outcome 3</p> <p>Clear description of the roles and responsibilities related to personal data and privacy protection, for humans and computers, applicable during project lifetime and after its finalisation.</p>	No
<p>Outcome 4</p> <p>Business model including an uptake strategy explaining the motivation, patient incentives and conditions for all stakeholders at the different levels (national, European, global) to support the GDI towards its sustainability, including data controllers, patients, citizens, data users, service providers (e.g., IT and biotech companies), healthcare systems and public authorities at large.</p>	No





<p>Outcome 5</p> <p>Sustained coordination mechanism for the GDI and for the GoE multi-country project launched in the context of the 1+MG initiative.</p>	<p>No</p>
<p>Outcome 6</p> <p>Communication strategy – to be designed and implemented at the European and national levels.</p>	<p>No</p>
<p>Outcome 7</p> <p>Capacity building measures necessary to ensure the establishment, sustainable operation, and successful uptake of the infrastructure.</p>	<p>Yes</p>
<p>Outcome 8</p> <p>Financial support to the relevant stakeholders to enable extension, upgrade, creation and/or physical connection of further data sources beyond the project consortium or to implement the communication strategy and for capacity-building.</p>	<p>No</p>





3. Methods

Deliverable scope and methodology

Title of deliverable: "Node mappings to TRLs"

Description of deliverable: "Initial report on each node mapping to TRL in the maturity model"

This initial status report on TRL mapping of the nodes has in addition to WP3 had natural involvement from WP5 "Technical Coordination and outreach", as well as from WP1 "Coordination and support". The quarterly self-reporting tool for mapping of node Operational Readiness Levels established by the GDI-coordination team in WP1 was chosen as the main data collection tool. The 8 reporting items categorised as technical in this tool together form a natural scope for the deliverable, together with a followup analysis and summary of the TRL mapping status results.

4. Description of work accomplished

The overall work that has been performed to produce this Deliverable can be summarised in the following:

- The GDI coordination team designed and implemented the GDI Nodes Operational Readiness tool¹ which defines the required TRL for each operational phase
- All GDI nodes were informed and were followed up to complete the self-reporting for the M03 quarterly reporting, due end of January 2023
- UiO as Deliverable responsible engaged in the following activities
 - Coordinated work distribution with WP3 and WP5 leads, and the GDI-coordination team
 - Discussed follow-up routines of data collection with GDI-coordination team
 - Monitored the data collection, and extracted data from the tool on 30-03-2023
 - Analysed the aggregated information
 - Formulated the deliverable report

4.1 Introduction to data collected

In the M03 quarterly reporting, 11 out of 20 nodes have updated their self-assessment of operational readiness in the GDI Nodes Operational Readiness tool. The following data items are collected in this tool in the Technical category with a pre-defined TRL to be met to qualify as an "Onboarded node":

¹https://docs.google.com/spreadsheets/d/1qJF5Jkh-lac43_zWvlyyNBCRMZwv3ktC77loxSxnOcs/edit#gid=1717294794

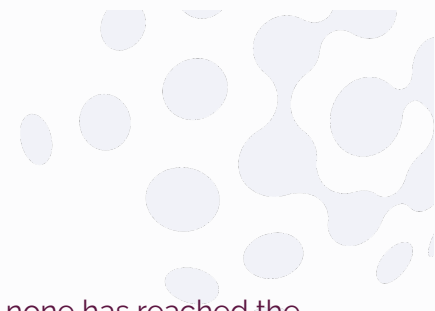


Table 1: Steps to be completed, with corresponding TRLs, for the first phase - onboarding

Phase	Step	Clarifications	TRL
Onboarding	API use cases considered, specifications drafted and implementation in progress	Specific GDI Node/ MS use case and associated requirements determined, and the specifications drafted which are required to meet these requirements, plus an implementation plan with demonstrable progress towards implementation	TRL 1. Basic principle observed
Onboarding	Decision on services and components utilised	Software services and components identified which support the identified use cases	TRL 2. Technology concept formulated
Onboarding	Software development best practises identified and implemented at the node		TRL 2. Technology concept formulated
Onboarding	Security mitigation, management, and reporting system being drafted.		TRL 2. Technology concept formulated
Onboarding	Compliance and stress tests drafted and refined in context of 1+MG requirements	While supporting the requirements of 1+MG (including recommendations from B1MG) the compliance and stress tests for the MS use cases and requirements have been drafted	TRL 2. Technology concept formulated
Onboarding	Have deployed or made available the initial physical infrastructure for the evaluation of the current PoC, or an upgraded version incorporating other additional use cases.	Physical infrastructure suitable for the PoC current at the time is available ready for the experimental node PoC to be deployed	TRL 2. Technology concept formulated
Onboarding	Have deployed and validated an instance or PoC or an upgraded version incorporating additional use cases	The experimental PoC has been deployed, and testing (unit, integration, functional, end-to-end, acceptance, and performance) has been successfully been completed	TRL 3. Experimental proof of concept
Onboarding	Load of synthetic data, functionalities demonstrated in development environment		TRL 4. Technology validated in a laboratory

Each of these data items has been answered by each responding node as “Yes”, “No”, or “Partially” indicating whether the specified TRL has been met or not. To be evaluated as a GDI node at the level of Onboarded, 8 out of 8 technical reporting items must be reported as “Yes”, in addition, 3 non-technical evaluation items not considered in this report, must also be met.





4.2 Summary of Node mapping to TRL

Out of the 11 nodes that have completed the self-assessment of TRL mapping, none has reached the complete mapping with 8 out of 8 to qualify as an “Onboarded node”. The following table summarises the countries degree of completion (Yes = 1, Partially = 0.5, No = 0):

Note: The current progress indicator is an arbitrary metric to provide an initial indication of progress until the individual roadmap for each country is defined and agreed before the end of year 1. The outcome presented here is part of the initial validation of the model, as such data would be much more accurate as the model is better defined/understood and we repeat the exercise (quarterly).

Table 2: Summary of completed steps in the onboarding phase

Target Phase (2026)	GD I Node	Vanguard Node?	Current Phase	Progress indicator: (Yes =1, Partially =0.5)
Operational	Belgium	Yes	TBD	2
Operational	Czech Republic		TBD	N/A
Operational	Denmark		TBD	2
Operational	Estonia		TBD	0
Operational	Finland	Yes	TBD	3
Operational	France		TBD	N/A
Operational	Germany		TBD	3.5
Operational	Italy		TBD	N/A
Operational	Luxembourg	Yes	TBD	1
Operational	Portugal		TBD	3
Operational	Slovenia		TBD	N/A
Operational	Spain	Yes	TBD	N/A
Operational	Sweden	Yes	TBD	6.5
Operational	The Netherlands	Yes	TBD	4.5
Operational	Norway	Yes	TBD	3.5
Deployment	Bulgaria		TBD	N/A
Deployment	Latvia		TBD	N/A
Deployment	Lithuania		TBD	N/A
Onboarding	Croatia		TBD	N/A
Onboarding	Ireland		TBD	0



4.2.1 TRL evaluation per node

Step	TRL	BE	DK	EE	FI	DE	LU	PT	SE	NL	NO	IE
API use cases considered, specifications drafted and implementation in progress	TRL 1.	p	n	n	y	p	p	n	y	p	y	n
Decision on services and components utilised	TRL 2.	p	n	n	y	p	n	p	y	p	y	n
Software development best practises identified and implemented at the node	TRL 2.	p	p	n	p	y	n	p	y	p	p	n
Security mitigation, management, and reporting system being drafted.	TRL 2.	n	y	n	p	p	n	n	y	y	p	n
Compliance and stress tests drafted and refined in context of 1+MG requirements	TRL 2.	n	p	n	n	n	n	n	p	p	n	n
Have deployed or made available the initial physical infrastructure for the evaluation of the current PoC, or an upgraded version incorporating other additional use cases.	TRL 2.	p	n	n	n	y	p	y	y	y	p	n
Have deployed and validated an instance or PoC or an upgraded version incorporating additional use cases	TRL 3.	n	n	n	n	n	n	p	y	p	n	n
Load of synthetic data, functionalities demonstrated in development environment	TRL 4.	n	n	n	n	n	n	p	n	n	n	n

Orange: Vanguard nodes

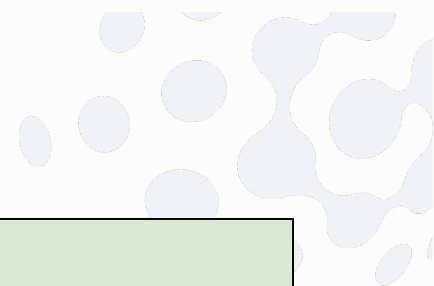
4.3 Individual Node mapping results including justification comments

4.3.1 Vanguard nodes

Belgium	TRL	Met	Justification / Evidences
API use cases considered, specifications drafted and implementation in progress	TRL 1.	Partially	Use cases requirements being determined, specifications and implementation in progress
Decision on services and components utilised	TRL 2.	Partially	
Software development best practises identified and implemented at the node	TRL 2.	Partially	Best practices identified and development team will be recruited
Security mitigation, management, and reporting system being drafted.	TRL 2.	No	
Compliance and stress tests drafted and refined in context of 1+MG requirements	TRL 2.	No	



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Have deployed or made available the initial physical infrastructure for the evaluation of the current PoC, or an upgraded version incorporating other additional use cases.	TRL 2.	Partially	Physical infrastructure acquired
Have deployed and validated an instance or PoC or an upgraded version incorporating additional use cases	TRL 3.	No	
Load of synthetic data, functionalities demonstrated in development environment	TRL 4.	No	

Finland	TRL	Met	Justification / Evidences
API use cases considered, specifications drafted and implementation in progress	TRL 1.	Yes	API and use cases considered within a national and international context, similar to the FEAGA node hosted at CSC
Decision on services and components utilised	TRL 2.	Yes	
Software development best practises identified and implemented at the node	TRL 2.	Partially	Recruitment in progress, mature development team in place for FEAGA and Sensitive Data Services
Security mitigation, management, and reporting system being drafted.	TRL 2.	Partially	ISO 27k certification on data center and management processes
Compliance and stress tests drafted and refined in context of 1+MG requirements	TRL 2.	No	Not started yet
Have deployed or made available the initial physical infrastructure for the evaluation of the current PoC, or an upgraded version incorporating other additional use cases.	TRL 2.	No	Deployed B1MG/1+MG Rare disease and cancer PoC
Have deployed and validated an instance or PoC or an upgraded version incorporating additional use cases	TRL 3.	No	
Load of synthetic data, functionalities demonstrated in development environment	TRL 4.	No	

Luxembourg	TRL	Met	Justification / Evidences
API use cases considered, specifications drafted and implementation in progress	TRL 1.	Partially	Use case requirements are being collected
Decision on services and components utilised	TRL 2.	No	
Software development best practises identified and implemented at the node	TRL 2.	No	
Security mitigation, management, and reporting system being drafted.	TRL 2.	No	
Compliance and stress tests drafted and refined in context of 1+MG requirements	TRL 2.	No	





Have deployed or made available the initial physical infrastructure for the evaluation of the current PoC, or an upgraded version incorporating other additional use cases.	TRL 2.	Partially	Initial physical infrastructure for testing identified
Have deployed and validated an instance or PoC or an upgraded version incorporating additional use cases	TRL 3.	No	
Load of synthetic data, functionalities demonstrated in development environment	TRL 4.	No	

Sweden	TRL	Met	Justification / Evidences
API use cases considered, specifications drafted and implementation in progress	TRL 1.	Yes	
Decision on services and components utilised	TRL 2.	Yes	Current set of components in place. However, updates will be done as the project develops.
Software development best practises identified and implemented at the node	TRL 2.	Yes	
Security mitigation, management, and reporting system being drafted.	TRL 2.	Yes	Security plan completed.
Compliance and stress tests drafted and refined in context of 1+MG requirements	TRL 2.	Partially	
Have deployed or made available the initial physical infrastructure for the evaluation of the current PoC, or an upgraded version incorporating other additional use cases.	TRL 2.	Yes	Infrastructure in place. PoC shown in B1MG.
Have deployed and validated an instance or PoC or an upgraded version incorporating additional use cases	TRL 3.	Yes	PoC successfully demonstrated in B1MG and FEQA.
Load of synthetic data, functionalities demonstrated in development environment	TRL 4.	No	

The Netherlands	TRL	Met	Justification / Evidences
API use cases considered, specifications drafted and implementation in progress	TRL 1.	Partially	A number of use-cases have been identified, we should choose which one to pursue. This decision will be taken in the MS team; closeness to the goals of Health-RI will be an important selection criteria
Decision on services and components utilised	TRL 2.	Partially	Software components will initially be taken from the starter kit; no specific use case has been chosen but any will be supported. We also are working on the EU portal component (specification concept).
Software development best practises identified and implemented at the node	TRL 2.	Partially	UMCG development processes and Health-RI Standard operating procedures. FAIR Genomes has defined national models.
Security mitigation, management, and reporting system being drafted.	TRL 2.	Yes	We are leading GDI WP6 ; ISMS being repurposed from TraIT project to Health-RI
Compliance and stress tests drafted and refined in context of 1+MG requirements	TRL 2.	Partially	Health-RI has standard processes in place, but not specifically adapted for 1+MG yet.





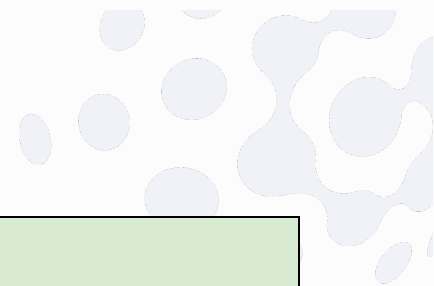
Have deployed or made available the initial physical infrastructure for the evaluation of the current PoC, or an upgraded version incorporating other additional use cases.	TRL 2.	Yes	Infrastructure from UMCG (CIT) ; Health-RI has contracts with certified hosting parties (like Vancis)
Have deployed and validated an instance or PoC or an upgraded version incorporating additional use cases	TRL 3.	Partially	Work in progress on starter kit as well as portal
Load of synthetic data, functionalities demonstrated in development environment	TRL 4.	No	Only possible when all of the above is done

Norway	TRL	Met	Justification / Evidences
API use cases considered, specifications drafted and implementation in progress	TRL 1.	Yes	
Decision on services and components utilised	TRL 2.	Yes	FEGA Norway is fully deployed and has signed the FEGA Collaboration Agreement. Services and software for other functionalities has been identified.
Software development best practises identified and implemented at the node	TRL 2.	Partially	
Security mitigation, management, and reporting system being drafted.	TRL 2.	Partially	
Compliance and stress tests drafted and refined in context of 1+MG requirements	TRL 2.	No	
Have deployed or made available the initial physical infrastructure for the evaluation of the current PoC, or an upgraded version incorporating other additional use cases.	TRL 2.	Partially	The infrastructure used for our FEGA test stack is equivalent to the production stack, and will be used for the GDI PoC. Some small adjustments are foreseen to cater for GDI specific adaptations.
Have deployed and validated an instance or PoC or an upgraded version incorporating additional use cases	TRL 3.	No	
Load of synthetic data, functionalities demonstrated in development environment	TRL 4.	No	

4.3.2 Remaining nodes (that have answered)

Denmark	TRL	Met	Justification / Evidences
API use cases considered, specifications drafted and implementation in progress	TRL 1.	No	
Decision on services and components utilised	TRL 2.	No	
Software development best practises identified and implemented at the node	TRL 2.	Partially	Agile/Scrum principles employed
Security mitigation, management, and reporting system being drafted.	TRL 2.	Yes	Full DPIA done, ITMS implemented, All operations ISO 27001/ISO 27701 Certified, All operations ISEA 3000 Approved
Compliance and stress tests drafted and refined in context of 1+MG requirements	TRL 2.	Partially	COmpliance and stress test part of overall NGC operational system



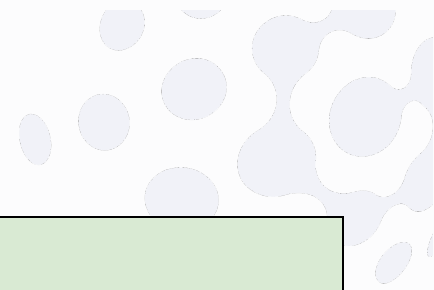


Have deployed or made available the initial physical infrastructure for the evaluation of the current PoC, or an upgraded version incorporating other additional use cases.	TRL 2.	No	
Have deployed and validated an instance or PoC or an upgraded version incorporating additional use cases	TRL 3.	No	
Load of synthetic data, functionalities demonstrated in development environment	TRL 4.	No	

Estonia	TRL	Met	Justification / Evidences
API use cases considered, specifications drafted and implementation in progress	TRL 1.	No	National node not yet defined (where it is, what data different genomic data owners can send there) and as a result implementation plan not drafted
Decision on services and components utilised	TRL 2.	No	Components that are in place have been mapped, national node's structure unknown
Software development best practises identified and implemented at the node	TRL 2.	No	Work-in-progress to produce a document
Security mitigation, management, and reporting system being drafted.	TRL 2.	No	
Compliance and stress tests drafted and refined in context of 1+MG requirements	TRL 2.	No	
Have deployed or made available the initial physical infrastructure for the evaluation of the current PoC, or an upgraded version incorporating other additional use cases.	TRL 2.	No	
Have deployed and validated an instance or PoC or an upgraded version incorporating additional use cases	TRL 3.	No	
Load of synthetic data, functionalities demonstrated in development environment	TRL 4.	No	

Germany	TRL	Met	Justification / Evidences
API use cases considered, specifications drafted and implementation in progress	TRL 1.	Partially	GHGA has been defined as the national node but implementation within GDI needs further refinement
Decision on services and components utilised	TRL 2.	Partially	Architecture for GHGA has been drafted, development of common exchange with GDI needs further development
Software development best practises identified and implemented at the node	TRL 2.	Yes	In place for the GHGA team
Security mitigation, management, and reporting system being drafted.	TRL 2.	Partially	Drafting of an ISMS for GHGA is ongoing
Compliance and stress tests drafted and refined in context of 1+MG requirements	TRL 2.	No	Alignment with 1+MG Requirements has not yet been started on a broad scale.
Have deployed or made available the initial physical infrastructure for the evaluation of the current PoC, or an upgraded version incorporating other additional use cases.	TRL 2.	Yes	Physical infrastructure for initial operation and PoC is in place





Have deployed and validated an instance or PoC or an upgraded version incorporating additional use cases	TRL 3.	No	
Load of synthetic data, functionalities demonstrated in development environment	TRL 4.	No	

Portugal	TRL	Met	Justification / Evidences
API use cases considered, specifications drafted and implementation in progress	TRL 1.	No	Check with INSA
Decision on services and components utilised	TRL 2.	Partially	The Starter Kit services and components will be utilised
Software development best practises identified and implemented at the node	TRL 2.	Partially	Best practices are identified. Some implemented using git.
Security mitigation, management, and reporting system being drafted.	TRL 2.	No	Meetings were held with the infrastructure providers to ensure these aspects
Compliance and stress tests drafted and refined in context of 1+MG requirements	TRL 2.	No	
Have deployed or made available the initial physical infrastructure for the evaluation of the current PoC, or an upgraded version incorporating other additional use cases.	TRL 2.	Yes	An Openstack infrastructure to support the PoC is deployed
Have deployed and validated an instance or PoC or an upgraded version incorporating additional use cases	TRL 3.	Partially	Some components of the PoC have been deployed, namely, the FEGA and the Beacon v2
Load of synthetic data, functionalities demonstrated in development environment	TRL 4.	Partially	A real, public dataset has been loaded into Beacon. FEGA has not yet been loaded.

Ireland	TRL	Met	Justification / Evidences
API use cases considered, specifications drafted and implementation in progress	TRL 1.	No	`we are still hiring staff
Decision on services and components utilised	TRL 2.	No	`we are still hiring staff
Software development best practises identified and implemented at the node	TRL 2.	No	`we are still hiring staff
Security mitigation, management, and reporting system being drafted.	TRL 2.	No	`we are still hiring staff
Compliance and stress tests drafted and refined in context of 1+MG requirements	TRL 2.	No	`we are still hiring staff
Have deployed or made available the initial physical infrastructure for the evaluation of the current PoC, or an upgraded version incorporating other additional use cases.	TRL 2.	No	`we are still hiring staff
Have deployed and validated an instance or PoC or an upgraded version incorporating additional use cases	TRL 3.	No	`we are still hiring staff
Load of synthetic data, functionalities demonstrated in development environment	TRL 4.		`we are still hiring staff





5. Results and discussion

From the gathered data in section 4, a number of observations can be made:

The understanding of the definitions provided for items in the self-reporting form may vary between countries, and therefore the precision level may similarly vary. It is expected that this understanding will converge with experience through repeated reporting periods and collaborative work.

The number of countries who partook in the TRL mapping at M03 is relatively low. This is likely due to the late hiring in the start of the project period or other general challenges in mobilising nodes, but a coordination function should ideally have been able to self-report at a minimal level from each node. A reasonable line of action would be to establish a technical level of contact to aid in understanding the definitions of the self-reporting, in particular for new nodes not yet familiar with the work entailed.

The average number of completed steps (the progress indicator values with range 0 to 8 for reaching completed onboarding status), are 1.7 for the non-vanguard nodes (5 reporting nodes, ranging from 0 to 3.5) and 3.42 for the vanguard nodes (6 reporting nodes, ranging from 1 to 6.5). This confirms that the vanguard nodes seem more mature, with a twofold average score compared to non-vanguard nodes.

The response rate in the groups is also indicating more operational readiness in the vanguard nodes in general, 6 respondents out of 7, vs 5 respondents out of 13 among the remaining nodes.

A noteworthy finding is that not a single node currently qualifies as being onboarded. In fact, the average number of steps completed by the vanguard nodes is lower than 50% of the target value of 8 steps completed for this readiness phase. With the preparations started to meet the M08 milestone, i.e. minimum 5 nodes having all 5 functionalities demonstrated in a test deployment with synthetic data, it is however expected that the progress indicator values will increase in the coming self-reporting periods for this group in particular.

6. Conclusions & Impact

The GDI self-reporting monitoring tool has proven itself very useful in gathering valuable data as ground for interesting findings: the overall participation was found to be lower than desirable, and even the top performing nodes have quite some progress remaining before reaching completion of the onboarding phase.

Slow project start-up is not surprising, but overall progress monitoring and follow-up in the start-up phase will be important to lay the ground for more consistent and representative progress reporting in the now coming phases of the project.



In order to ensure timely progress, a more agile collaboration approach may help to achieve operational status in 15 nodes by October 2026.

7. Next steps

The next steps will consist of:

- a) allowing more guidance to nodes that are starting from scratch, to lower a possibly perceived threshold to get started with this type of self-reporting.
- b) executing the M06 periodic reporting
- c) updating the summary tables of this report to compare for significant improvements in i) attendance, ii) quality of answers and iii) deployment progress.

We suggest that the Task 3.1 Onboarding lead assisted by the WP5 Technical coordination and the WP1 GDI coordination team take responsibility for implementing the suggested actions.

