¡¡DELIVERABLE UNDER REVIEW PROCESS!!

VELaSSCo

***V**isual Analysis for **E**xtremely **La**rge-**S**cale*
***S**cientific **Co**mputing*

D1.5 – Definition of criteria and methodology for system evaluation.

Version #1

Deliverable Information

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1 Introduction

This deliverable aims at providing a solid methodology for system evaluation. The Goal/Metric/Question (GQM) methodology was used to identify the questions and to then enable the initial set of users and technical requirements of the VeLASSCo framework, identifying the main features the project is aiming at. GQM was chosen precisely to get from the objectives to the actual metrics, providing a measurement model on three levels [3]:

- Conceptual level (goal). A goal is defined for an object, for a variety of reasons, with respect to various models of quality, from various points of view, and relative to a particular environment.
- Operational level (question). A set of questions is used to characterize the assessment/achievement [how] of a specific goal is going to be performed based on some model.
- Quantitative level (metric). A set of data is associated with every question in order to answer it in a quantitative way.

At this point, we should not provide a detailed evaluation plan at this stage of the project, but rather the guidelines and methodology for the evaluation process. This deliverable D1.5 will therefore provide the main evaluation plan to identify the methodology, the first set of criteria to validate the VeLASSCo framework, and a draft of the questionnaires to be used in the evaluation process. These questionnaires would need to be refined along the way in order to cover the gathering of the necessary data collection as the VeLASSCo framework evolves and is grounded to specific technologies and covering particular usage scenarios. The second version of this deliverable (D1.6) will provide the necessary additions and refinements of the evaluation methodology based on the lessons learned in the first iteration and the evolution of the metrics based in the GQM methodology.

2 Methodological approach for the system evaluation

In Velassco we have already delivered the initial set of use case and technical requirements following the GQM methodology. We plan to use the existing GQM information to set up an evaluation plan in several phases according to [4].

Taking into account that GQM can be applied in cycles, each cycle will refine the measurement program and the VeLASCCo System as well. Figure 1 shows the complete GQM cycle and its steps in general.

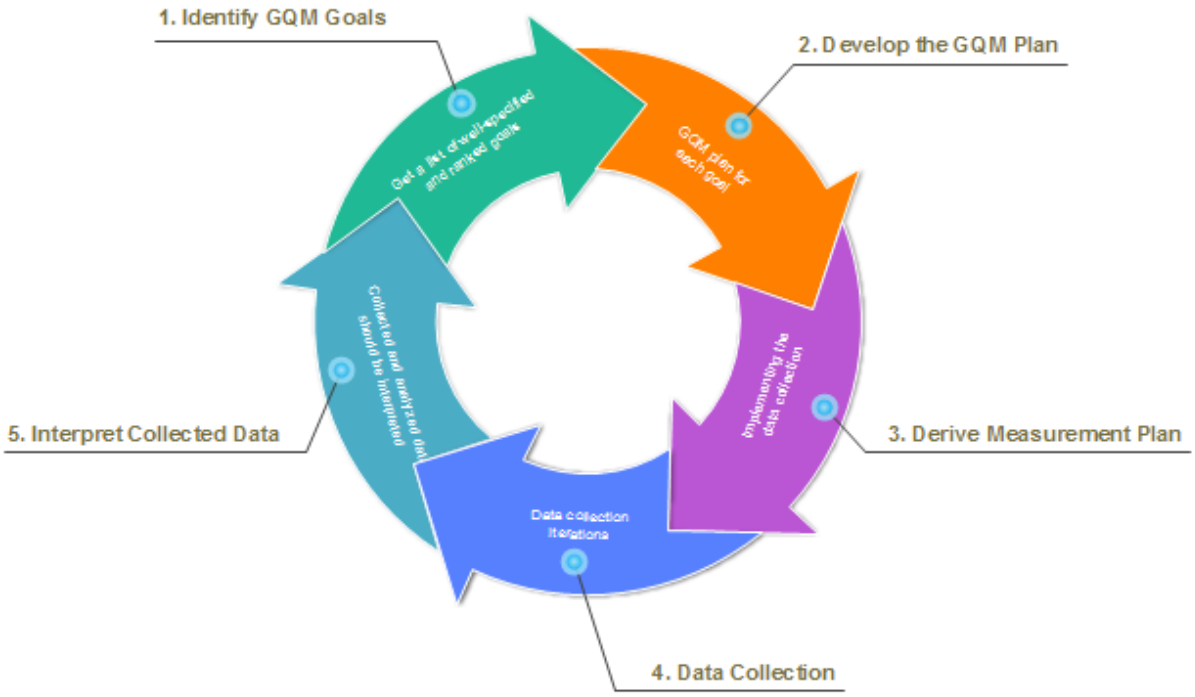

Figure 1. VeLASCCo GQM standard cycle.

The instantiation of single steps in GQM cycle for VeLASSCo are described in detail in the following:

- **Identify GQM Goals**. The objective of identifying goals is to get a list of well-specified and ranked goals. First, informal goals are collected. Second, they are formalized according to the template for GQM goals. Third, the goals are ranked, and, fourth, the ones to be used in the measurement program are selected.
- **Develop GQM Plan**. The objective of this step is to develop a GQM plan for each goal, that is, an operational refinement of a GQM goal via questions into measures including the analysis models that specify how the measurement data is analyzed to help answer the questions. This is done as a two-step process: 1) Interviews with experts to set the goals; 2) Derive a GQM plan for

each goal, deriving a set of questions. The approach defined in [4] recommends doing so creating abstraction sheets in the interviews into quality factors, baseline hypothesis, variation factors and impact of variation factors. But in Velassco the gathering of goals and questions was done using a less formal approach.

- **Derive Measurement Plan**. [4] The objective of this step is to implement the data collection. Thus, the GQM plans must be linked with the usage processes of the VeLASSCo system. This is documented in the form of a measurement plan that describes for all measures from all GQM plans of the measurement program which measurement data is collected when, how, by whom, and who validates and stores the data. Finally, the data collection procedures are implemented, that is, questionnaires (paper-based or on-line) and automatic data collection procedures are developed.
- **Data Collection**. We have to think on the different data collection phases for the VeLASSCo evaluation. Providing that we will evalutate the system in two iterations, for the first iteration [4] of the measurement program, only data from usage trials with the experts and some other persons will be collected. This will help to validate the data collection procedures and get first results. For the second iteration of the measurement program, data from real use is being collected. This also includes data about usage of the VeLASSCo system in HPC, metrics of performance of the simulations done using the different parts of the architecture (i.e. Hadoop) and the way the users perceive the benefits of the system. The collected data must also be validated including questions about the completeness of the data in the questionnaires.
- **Interpret Collected Data**. [4] The collected and analyzed data should be interpreted in feedback sessions with the experts. Thus, the objectives of these feedback sessions are the interpretation of the results of measurement data analyses, the verification of the hypotheses in terms of metrics stated in the GQM plans, the comparison of the results to the goals, the evaluation of the measurement program, and the identification of the possibilities for improvement of both the software system and the measurement program. The interpretations, results, and decisions are explicitly written down in the minutes for the feedback session.

3 Framework Overview

The proposed framework has five key dimensions showing in Figure 2 for describing the VeLASSCo System: End-User Functionalities, SW Architecture and Deployment Environment, Navigation and Interaction, Algorithms and Views.
End-User Functionalities refers to business actions offered by VeLASCCo System from the end user perspective. SW Architecture and Deployment Environment consider the definition, implementation and deployment in the production environment of the SW pieces integrated by means an integration framework. Navigation and Interaction characterizes the ease of use of the VeLASSCo SW System. Algorithms represent the processes of multi-resolution, coarsening, coordinates, connectivity and results compaction. Finally, Views characterize the perspective of the VeLASCCo observers focusing on effectiveness aspects that can help to these to take decisions.

The GQM paradigm will be used by each of these five key dimensions to identify the questions and to then enable the formation of the framework features.

Figure 2. VeLASSCo Evaluation Framework Dimensions.

Following the steps of the GQM evaluation methodology proposed, we will set up a series of metrics to evaluate the system. In many cases metrics would be scenario or use case-specific, meaning that the system would need to achieve different

quantitative measurements for the same metric, or even some metrics would not apply to certain scenarios.

Measures in GQM plans can be qualitative and quantitative as well as subjective and objective. Besides, some metrics are fuzzy by nature. For instance the reduction of storage space is apparently straightforward to measure, but the big data and simulation technology proposed in VeLASSCo could be used to store even more quantity of data than before, so some specific algorithms to calculate the right metric (such as the cost in €-per-TB) should be established and discussed in the course of the project.

Although it is difficult to anticipate the metrics groups and thresholds, there are clear examples of some of them to be aligned with the main objectives of VeLASSCo:

- Distributed computing infrastructures metrics: Big Data Management metrics (system scalability, effectiveness…), Costs metrics (storage reduction per TB, hardware costs…), etc.

- Data analytics for simulation data: Number of approaches followed, processing time reduction or feasibility for simulation (for different system configurations and different classes of datasets), etc.

- Scalable visualization: Scalability of queries metrics (for real-time and historical data), time for visualization metrics (for real-time and historical data), etc.

- End user test beds (scenario-specific metrics): Number of scenarios covered, number of scenario-specific post-processing algorithms and methods developed.

Following the GQM steps described in Section 2 in all the dimensions provides a straightforward way to generate the global set of goals, questions and metrics for the VeLASSCo System.

4 Applying the Framework

Applying the GQM cycle for the first Iteration which is currently on going we present the results obtained in each of the steps by each of the dimensions defined in the evaluation framework in the following.

4.1 End-User Functionalities Dimension

The current status of progress applying the GQM cycle over End-User Functionalities Dimension is shown in Figure 3.

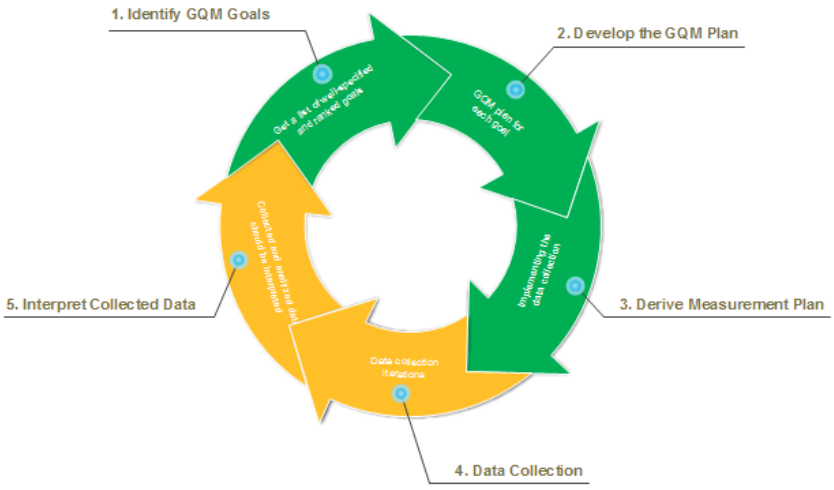

Figure 3. GQM cycle status over End-User Functionalities Dimension

4.1.1 Identification of GQM Goals

The goals obtained as result of covering step 1 are listed in Table 1.

Goal	Description	Parent Goal	WP linked to
G.EU#1	Handle very large and complex data files	-	WP2
G.EU#2	Simulation & Post-processing communication	-	WP2, WP3
G.EU#2.1	Runtime/Offline Data handling/Analytics	G#2	WP2, WP3
G.EU#2.2	Self-optimization of simulation parameters	G#2	WP2, WP3
G.EU#3	Able to interact with the remote distributed data from personal computer	-	WP2, WP3
G.EU#4	Able to interact with an existing HPC systems	-	WP2, WP3

G.EU#5	Confidentiality	-	WP2, WP3, WP4

Table 1. GQM Goals for End-User Functionalities

4.1.2 Development of GQM Plan

The Model (set of questions) obtained as result of covering step 2 is listed in Table 2.Table 1

Question	Description	Associated Goal
Q#1	What is the size of the data files?	G.EU#1
Q#2	How many particles are involved in the simulation?	G.EU#1
Q#3	How many time steps per simulation?	G.EU#1
Q#4	How many results/variable can be handled?	G.EU#1
Q#5	How can data file size be optimized?	G.EU#1
Q#6	How fast can be the communication solver-post-processing?	G.EU#2, G.EU#2.1
Q#7	How long does the data loading process take?	G.EU#2.1, G.EU#2.2
Q#8	How long does the data writing process take?	G.EU#2, G.EU#2.1
Q#9	How many simulation parameters can be optimized?	G.EU#2, G.EU#2.1, G.EU#2.2
Q#10	Are selective parameters during runtime possible?	G.EU#1, G.EU#2, G.EU#2.1, G.EU#2.2
Q#11	What is the ratio of visualisation time/ data save interval (sampling frequency)?	G.EU#1
Q#12	Where are the data located?	G.EU#3
Q#13	Which is the layout of the data?	G.EU#3
Q#14	Is the interaction flow the desired one?	G.EU#3
Q#15	What is the time-lag between the user's (first, subsequent) request and the system answer? (May be several questions for the several queries to be performed)	G.EU#3
Q#16	Is this speed improving?	G.EU#3
Q#17	Does the user have a feed-back between request and answer?	G.EU#3

Q#18	Which is the acceptable waiting time to get feed-back between request and answer?	G.EU#3
Q#19	Does the user accept a temporary answer while the exact answer is being computed?	G.EU#3
Q#20	Can the error or missing data be tracked and overcome?	G.EU#3
Q#21	How does the system perform?	G.EU#4
Q#22	How does VELaSSCo platform behave with a production environment?	G.EU#4
Q#23	Are the data secured?	G.EU#5
Q#24	Is the access secure?	G.EU#5

Table 2. GQM questions for End-User Functionalities

4.1.3 Measurement Plan

The metrics obtained as result of covering step 3 are listed in Table 3.

Metrics	Description	Associated Question	Value
M#1	Dataset Size	Q#1, Q#5	up to petabyte but the great majority are a lot smaller - approx. 50Gb
M#2	Number of particles	Q#2, Q#5	up to 10^7
M#3	Number of computational time steps	Q#3, Q#5	up to 10^9
M#4	Number of results at particle level	Q#4, Q#5	Min. of 10 variables
M#5	Number of results at bulk/continuum level (Stress calculation)	Q#4, Q#5	Min. of 14 variables
M#6	Number of simulated time steps/Number of post-processed time steps	Q#6	Less than 50
M#7	Processing time per simulated time step (s)	Q#7, Q#8, Q#13	Less than 10 seconds

M#8	Number and type of parameters	Q#7, Q#8	Less than 10 seconds
M#9	Number of parameters to be optimized	Q#9	Minimum of 3
M#10	Ability to discard unwanted information	Q#4, Q#10	NA
M#11	Visualisation frame rate	Q#11	
M#12	Number of node with data, how are the connected.	Q#12	10^7 … 10^9 nodes on a tetrahedral mesh
M#13	Structured data, redundancy, distributed parts, time steps	Q#13	1 domain, 4 … 1024 sub-domains, 50 … 25,000 time-steps
M#14	Define an interaction flow and rate it by the user.	Q#14	
M#15	Average time	Q#15	Depending on the query, from seconds to minutes
M#16	Percentage over initial timing	Q#16	%
M#17	Feedback for the user	Q#17	questionnaire
M#18	Time between request and any answer	Q#18	seconds
M#19	Similarity between temporary and final answer	Q#19	Visual similarity
M#20	Check traceability of errors	Q#20	Cause and trace an error
M#21	Queries per sec	Q#21	Tens of queries
M#22	Time of query execution	Q#22	Tools to make possible cohabitation with simulations codes
M#23	Percentage of resources usage	Q#22	CPU / memory / communication / disk usage
M#24	Security guidelines regarding the storage of data	Q#23	
M#25	Login and access protocol (ssh or ssl)	Q#24	User and password

Table 3. GQM Metrics for End-User Functionalities

4.1.4 Data Collection.

Step not started.

Proposed Tools: Nagios, Nagios Network Analyzer and SOASTA Cloud Lite.

4.1.5 Interpret Collected Data.

Step not started.

Proposed Tools: To interpret the collected data in step 4, we will make use of "*Radar Charts"* that allow us to compare results from main test scenarios defined in Section 5.

4.2 SW Architecture and Deployment Environment Dimension

The current status of progress applying the GQM cycle over SW Architecture Dimension is shown in Figure 4.

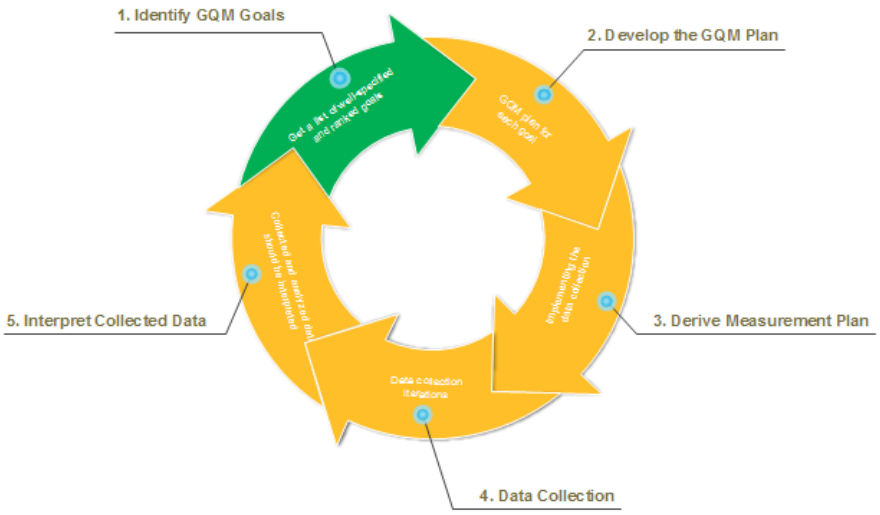

Figure 4. GQM cycle status over SW Architecture Dimension.

4.2.1 Identification of GQM Goals

The goals obtained as result of covering step 1 are listed in Table 4Table 1.

Goal	Description	Parent Goal	WP linked to
G.AD#1	Multi-platform and portable visualization: from HPC to PC	-	WP2, WP4
G.AD#2	Specification of the big data architecture most suitable for simulation data.	-	WP2
G.AD#3	Data storage design for the HPC cloud infrastructure for engineering analysis	-	WP2

G.AD#3.1	Identification of a suitable engineering friendly petabyte size data format that supports open standards, that is, a non-proprietary format for re-use of WP3 and WP4 results	G.AD#3	WP2, WP3, WP4
G.AD#3.2	Find and deploy a commercial/academic HPC cloud infrastructure that matches the design.	G.AD#3	WP2, WP3, WP4

Table 4. GQM Goals for SW Architecture.

4.2.2 Development of GQM Plan

Step currently on going.

4.2.3 Measurement Plan

Step currently on going.

4.2.4 Data Collection.

Step not started.

Proposed Tools: Nagios, Nagios Network Analyzer and SOASTA Cloud Lite.

4.2.5 Interpret Collected Data.

Step not started.

Proposed Tools: To interpret the collected data in step 4, we will make use of "*Radar Charts"* that allow us to compare results from main test scenarios defined in Section 5.

4.3 Algorithms Dimension

The current status of progress applying the GQM cycle over Analysis Algorithms Dimension is shown in Figure 5.

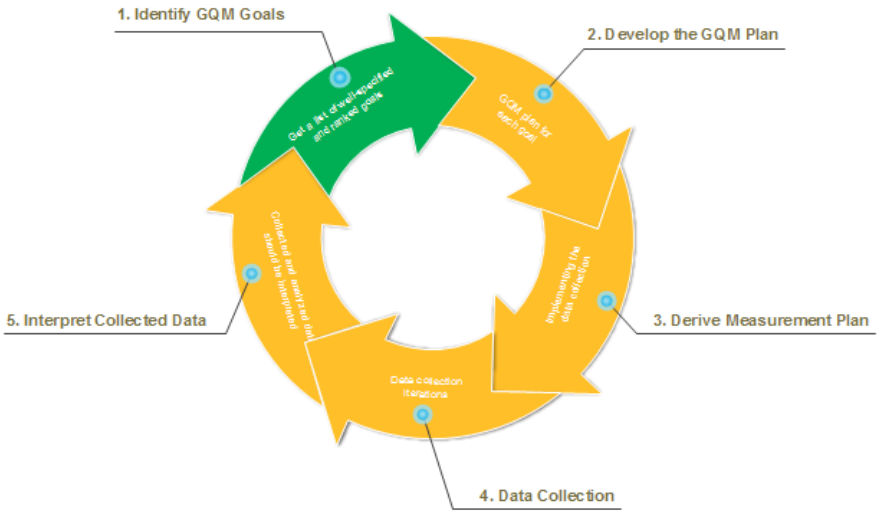

Figure 5. GQM cycle status over Algorithms Dimension.

4.3.1 Identification of GQM Goals

The goals obtained as result of covering step 1 are listed in Table 5.

Goal	Description	Parent Goal	WP linked to
G.AL#1	Definition of algorithms to generate multi-resolution models and compressed geometry and results information	-	WP3
G.AL#2	Definition of common and specific algorithms to extract the desired results for DEM/FEM simulations	-	WP3
G.AL#3	Definition of algorithms to format the generated results for the visualization platform	-	WP3
G.AL#4	Dataset analysis	-	WP3
G.AL#5	Statistics of variables	-	WP3

Table 5. GQM Goals for Algorithms.

4.3.2 Development of GQM Plan

Step currently on going.

4.3.3 Measurement Plan

Step currently on going.

4.3.4 Data Collection.

Step not started.

Proposed Tools: Nagios, Nagios Network Analyzer and SOASTA Cloud Lite.

4.3.5 Interpret Collected Data.

Step not started.

Proposed Tools: To interpret the collected data in step 4, we will make use of "*Radar Charts"* that allow us to compare results from main test scenarios defined in Section 5.

4.4 Navigation and Interaction Dimension

The current status of progress applying the GQM cycle over Navigation and Interaction Dimension is shown in Figure 6Figure 5Figure 4.

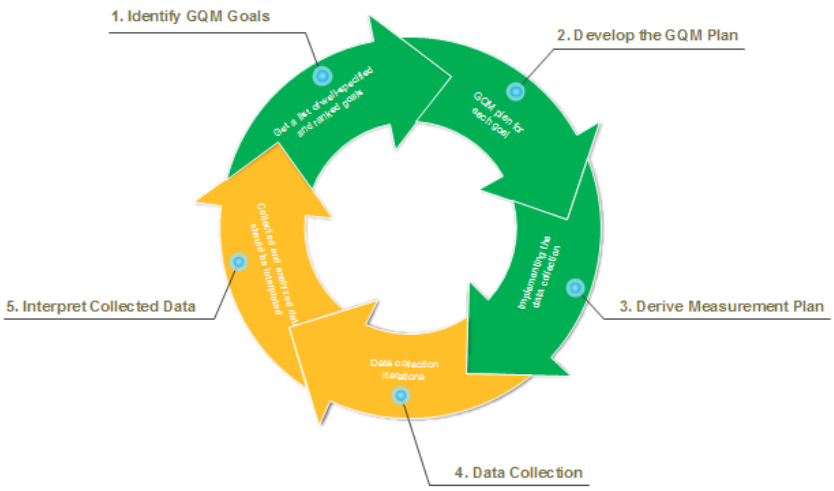

Figure 6. GQM cycle status over Navigation and Interaction.

4.4.1 Identification of GQM Goals

The goals obtained as result of covering step 1 are listed in Table 4Table 1.

Goal	Description	Parent Goal	WP linked to
G.NI#1	Friendly and intuitive graphical user interface	-	WP1, WP4, WP5
G.NI#2	Detailed user manual and tutorials	-	WP1, WP4, WP5

Table 6. GQM Goals for Navigation and Interaction.

4.4.2 Development of GQM Plan

"VeLLASCo Usability Questionnaire" attached in Annex and based on [6] represents the Model or set of questions associated to the two high level goals defined in step 1. In concrete, the Questionaire contains 23 questions

4.4.3 Measurement Plan

Scale defined in "VeLLASCo Usability Questionnaire" and based on [6] will be used as a quantitative metric for each of the questions included in the Questionnaire. The values range goes from "Strongly Agree" (1) to "Strongly Disagree" (7).

4.4.4 Data Collection.

Step not started.

Proposed Tools: Tool proposed for covering this step is "VeLLASCo Usability Questionaire" attached in Annex.

4.4.5 Interpret Collected Data.

Step not started.

Proposed Tools: To interpret the collected data in step 4, we will make use of "*Radar Charts"* that allow us to compare questionnaire answers provided by the end users.

4.5 Views Dimension

The current status of progress applying the GQM cycle over Views Dimension is shown in Figure 7.

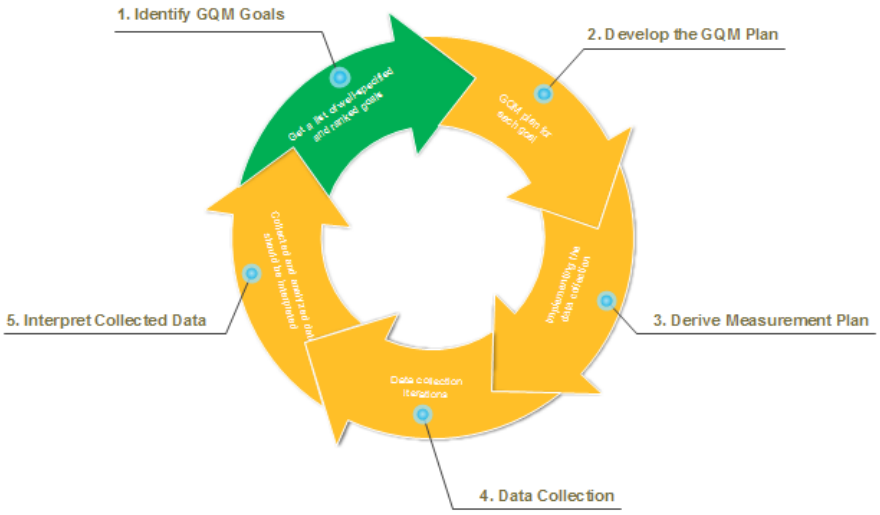

Figure 7. GQM cycle status over Views.

4.5.1 Identification of GQM Goals

The goals obtained as result of covering step 1 are listed in Table 4Table 1.

Goal	Description	Parent Goal	WP linked to
G.NI#1	Efficient communication between simulation solver and post-processing	-	WP2, WP3, WP4
G.NI#2	Run time & Offline analytics	-	WP2, WP3, WP4
G.NI#3	Able to interact with the model (or a simplified representation) at interactive rates: zoom, rotate, etc.	-	WP2, WP3, WP4
G.NI#4	Able to get full-resolution results	-	WP2, WP3, WP4
G.NI#5	Acceptable waiting time of minutes for some queries, if longer, some feedback should be provided.	-	WP2, WP3, WP4

G.NI#6	Acceptable waiting time of minutes for some queries, if longer, some feedback should be provided.	-	WP2, WP3, WP4
G.NI#7	Contour fill visualization of user selected result over skin, cut-planes or iso-surfaces.	-	WP2, WP3, WP4
G.NI#8	Vector visualization (with some kind of filtering or coarsening) on the volume data (added-value), skin, cut-planes or iso-surfaces .	-	WP2, WP3, WP4
G.NI#9	Real time visualization of results to make decisions on the simulations	-	WP2, WP3, WP4
G.NI#10	Real time visualization of results to make decisions on the simulations	-	WP2, WP3, WP4
G.NI#11	Temporal and Spatial averaging of the results		
G.NI#11.1	Adjustment of the interval time for temporal averaging	G.N#11	WP2, WP3, WP4
G.NI#11.2	Adjustment of length scale for spatial averaging	G.N#11	WP2, WP3, WP4
G.NI#11.3	Tools to decide the relevant temporal and spatial averaging scales for each problem	G.N#11	WP2, WP3, WP4
G.NI#12	Visualization and tracking of complex particle shapes	-	WP2, WP3, WP4
G.NI#12.1	Easy way to import and define particle shape	G.N#12	WP2, WP3, WP4
G.NI#13	Visualization of large data sets over many time steps	-	WP2, WP3, WP4
G.NI#13.1	Fast visualisation of results	G.N#13	WP2, WP3, WP4
G.NI#13.2	Adaptive resolution for the different zoom scales	G.N#13	WP2, WP3, WP4
G.NI#14	Visual comparison of results from different datasets	-	WP2, WP3, WP4

Table 7. GQM Goals for Views.

4.5.2 Development of GQM Plan

Step currently on going.

4.5.3 Measurement Plan

Step currently on going.

4.5.4 Data Collection.

Step not started.

Proposed Tools: Nagios, Nagios Network Analyzer and SOASTA Cloud Lite.

4.5.5 Interpret Collected Data.

Step not started.

Proposed Tools: To interpret the collected data in step 4, we will make use of "*Radar Charts"* that allow us to compare results from main test scenarios defined in Section 5.

5 Definition of Scenarios for Evaluation

Evaluation of the results will be performed in several iterations. The major iterations will coincide with the release of the major software components, but smaller iterations which take place during the whole life-time of the project.

From the data nature point of view we can consider the following use cases mentioned in VeLASSCo D1.1. End-users requirements and Users panel.:

- **DEM:** The VELaSSCo platform should handle three groups of scenario:
  - One big model with few time steps.
  - One small model with a lot of time steps.
  - One model runs several times with parameters sensitivity.
- **FEM**: The VELaSSCo platform should handle two possible scenarios:
  - Huge simulation with distributed results and several time steps of an HPC cluster.
  - Plenty of simulations distributed on several computers.

The evaluation will be carried out by professionals on the different domains, as specified in the use case scenarios, both for the usability and for the effectiveness and performance of the proposed solutions.

From the architectural point of view, during the Oslo technical meeting the discussions regarding runtime scenarios resulted in the two drafts for use cases 1 and 2 respectively consisting of:

- **Scenario 1**: All data are on one file system
- **Scenario 2**: Cluster nodes are connected via Ethernet

For both use cases model mesh, time steps and results are all distributed and need to be merged before final storage.

6 Data Collection Tools

For covering the data collection step in the GQM cycles a brief description of proposed tools is provided in the following.

6.1 Nagios monitor tool[1]

Nagios is an open source monitoring system that enables organizations to identify and resolve IT infrastructure problems before they affect critical business processes. Nagios has been designed in order to offer scalability and flexibility to your platform to keep your organization's business processes away from outages and unexpected system failures. To sum up, Nagios is a powerful tool that provides you with instant awareness of your IT infrastructure and allows you to detect and repair problems and mitigate future issues before they affect end-users and customers.

6.2 Nagios Network Analyzer[2]

Nagios Network Analyzer is a commercial network flow solution that provides extended insight into their IT infrastructure and network traffic. Its main features include advanced information graphics, real-time statistics and a set of functionalities that focuses on extract information that runs over an organization platform. Also, Network Analyzer allows you to be proactive in resolving system failures, outages, abnormal behavior, and security threats before they affect critical business processes. Nagios Network Analyzer provides network traffic and bandwidth information for your entire IT infrastructure and ensures that systems, applications, services, and business processes are functioning properly.

6.3 SOASTA CloudTest Lite[3]

SOASTA CloudTest Lite is a powerful web and mobile testing platform that allows simulate executions over your IT infrastructure and offers useful metrics information about its performance. CloudTest Lite is a free downloadable trial edition that offers you an almost complete functionalities version to assess your platform. It delivers rapid test creation, a visual interface, real-time analytics for test automation and performance testing throughout the application development lifecycle. The main goal of CloudTest Lite version is to empower developers, performance engineers and QA teams to test faster and more effectively their platform and infrastructures.

[1] http://www.nagios.org/about/overview/

[2] http://www.nagios.com/products/nagios-network-analyzer

[3] http://www.soasta.com/products/cloudtest-lite/

7 Conclusions

In this deliverable, we present a summary of the efforts provided in task T1.3 related to the “Usability criteria, test and questionnaires definition”.

Firstly, in the document have been described the guidelines and methodology for the evaluation process which is mainly based on GQM cycle.

Secondly, the deliverable provides a description of the Evaluation Framework proposed for VeLASSCo next to the first results in each of the GQM cycle for each dimension defined in the Evaluation Framework. Therefore, as result of the first iteration over GQM cycles the first global set of criteria to validate the VeLASSCo framework (metrics), and a draft of the usability questionnaire to be used in the evaluation process were obtained. This questionnaire would need to be refined along the way in order to cover the gathering of the necessary data collection as the VeLASSCo framework evolves and is grounded to specific technologies and covering particular usage scenarios.

Finally, tentative use case scenarios next to a set of tools proposed for data collection in the final steps of GQM cycles were presented in the document.

The second version of this deliverable will provide the necessary additions and refinements of the evaluation methodology based on the lessons learned in the first iteration and the evolution of the metrics based in the GQM methodology.

8 Annex

8.1 VeLLASCo System Usability Questionnaire

Participant: _____

System: _____

This questionnaire gives you an opportunity to tell us your reactions to the system you used. Your responses will help us understand what aspects of the system you are particularly concerned about and the aspects that satisfy you.

To as great a degree as possible, think about all the tasks that you have done with the system while you answer these questions.

Please read each statement and indicate how strongly you agree or disagree with the statement by circling a number on the scale. If a statement does not apply to you, circle N/A.

Please write comments to elaborate on your answers.

As you complete the questionnaire, please do not hesitate to ask any questions.

Thank you!

8.2 Usability Questionnaire Quesions

1. Overall, I am satisfied with how easy it is to use this system.

STRONGLY AGREE 1 2 3 4 5 6 7 STRONGLY DISAGREE

COMMENTS:

2. It was simple to use this system.

STRONGLY AGREE 1 2 3 4 5 6 7 STRONGLY DISAGREE

COMMENTS:

3. I could effectively complete the tasks and scenarios using this system.

STRONGLY AGREE 1 2 3 4 5 6 7 STRONGLY DISAGREE

COMMENTS:

4. I was able to complete the tasks and scenarios quickly using this system.

STRONGLY AGREE 1 2 3 4 5 6 7 STRONGLY DISAGREE

COMMENTS:

5. I was able to efficiently complete the tasks and scenarios using this system.

STRONGLY AGREE 1 2 3 4 5 6 7 STRONGLY DISAGREE

COMMENTS:

6. I felt comfortable using this system.

STRONGLY AGREE 1 2 3 4 5 6 7 STRONGLY DISAGREE

COMMENTS:

7. It was easy to learn to use this system.

STRONGLY AGREE 1 2 3 4 5 6 7 STRONGLY DISAGREE

COMMENTS:

8. I believe I could become productive quickly using this system.

STRONGLY AGREE 1 2 3 4 5 6 7 STRONGLY DISAGREE

COMMENTS:

9. The system gave error messages that clearly told me how to fix problems.

STRONGLY AGREE 1 2 3 4 5 6 7 STRONGLY DISAGREE

COMMENTS:

10. Whenever I made a mistake using the system, I could recover easily and quickly.

STRONGLY AGREE 1 2 3 4 5 6 7 STRONGLY DISAGREE

COMMENTS:

11. The information (such as on-line help, on-screen messages and other documentation) provided with this system was clear.

STRONGLY AGREE 1 2 3 4 5 6 7 STRONGLY DISAGREE

COMMENTS:

12. It was easy to find the information I needed.

STRONGLY AGREE 1 2 3 4 5 6 7 STRONGLY DISAGREE

COMMENTS:

13. The information provided for the system was easy to understand.

STRONGLY AGREE 1 2 3 4 5 6 7 STRONGLY DISAGREE

COMMENTS:

14. The information was effective in helping me complete the tasks and scenarios.

STRONGLY AGREE 1 2 3 4 5 6 7 STRONGLY DISAGREE

COMMENTS:

15. The organization of information on the system screens was clear.

STRONGLY AGREE 1 2 3 4 5 6 7 STRONGLY DISAGREE

COMMENTS:

Note: *The "interface" includes those items that you use to interact with the system. For example, some components of the interface are the keyboard, the mouse, the microphone, and the screens (including their use of graphics and language).*

16. The interface of this system was pleasant.

STRONGLY AGREE 1 2 3 4 5 6 7 STRONGLY DISAGREE

COMMENTS:

17. I liked using the interface of this system.

STRONGLY AGREE 1 2 3 4 5 6 7 STRONGLY DISAGREE

COMMENTS:

18. This system has all the functions and capabilities I expect it to have.

STRONGLY AGREE 1 2 3 4 5 6 7 STRONGLY DISAGREE

COMMENTS:

19. Overall, I am satisfied with this system.

STRONGLY AGREE 1 2 3 4 5 6 7 STRONGLY DISAGREE

COMMENTS:

20. I would buy and use this system software.

STRONGLY AGREE 1 2 3 4 5 6 7 STRONGLY DISAGREE

COMMENTS:

21. I would recommend this system software to others.

STRONGLY AGREE 1 2 3 4 5 6 7 STRONGLY DISAGREE

COMMENTS:

22. Please list the three things you liked most about this system software.

23. Please list the three things you liked least about this system

9 References

[1] V. Basili, G. Caldiera, and H.D. Rombach, "The Goal Question Metric Paradigm," Encyclopedia of Software Eng., vol. 2, pp. 528-532, John Wiley & Sons, 1994.

[2] S. Bassil and R. Keller, "A Qualitative and Quantitative Evaluation of Software Visualization Tools," Proc. 23rd IEEE Int'l Conf. Software Eng. Workshop Software Visualization, pp. 33-37, 2001.

[3] K. Gallagher, A. Hatch, M. Munro, "Software Architecture Visualization: An Evaluation Framework and Its Application". IEEE Transactions on Software Engineering, vol. 34, no. 2, March/Aapril 2008.

[4] Markus Nick, Klaus-Dieter Althoff, Carsten Tautz, "Facilitating the Practical Evaluation of Organizational Memories Using the Goal-Question-Metric Technique". KAW'99 – Twelfth Workshop on Knowledge Acquisition, Modeling and Management Track "Evaluation of KE Techniques"

[5] VeLASSCo D1.1. End-users requirements and Users panel.

[6] Lewis, J. R. (1995) IBM Computer Usability Satisfaction Questionnaires: Psychometric Evaluation and Instructions for Use. International Journal of Human-Computer Interaction, 7:1, 57-7.