



Q-Rapids

D5.2 Validation Design

V1.0

Programme	H2020		
Funding scheme	RIA - Research and Innovation action		
Topics	ICT-10-2016 - Software Technologies		
Project number	732253		
Project name	Quality-aware rapid software development		
Project duration	1 st November 2016 – 31 st October 2019		
Project website	www.q-rapids.eu		
Project WP	WP5 – <i>Evaluation</i>		
Project Task	<i>Task 5.2 – Development of individual evaluation designs</i>		
Deliverable type	X	R	Document, report
		DEM	Demonstrator, pilot, prototype
		DEC	Websites, patent filings, videos, etc.
		OTHER	Material that does not belong to any specified category
		ETHICS	Ethics requirement
Contractual delivery	01/11/2017		
Delivered	01/11/2017		
Responsible beneficiary	Organisation		
	X	PU	Public
		CO	Confidential, only for members of the consortium (including the Commission Services)
		EU-RES	Classified Information: RESTREINT UE (Commission Decision 2005/444/EC)
		EU-CON	Classified Information: CONFIDENTIEL UE (Commission Decision 2005/444/EC)
		EU-SEC	Classified Information: SECRET UE (Commission Decision 2005/444/EC)



Version history			
Version no.	Date	Description	Author
V0.1	30/06/2017	Annotated Outline	Liliana Guzmán (Fraunhofer IESE)
V0.2	14/07/2017	Object of Study, Evaluation Goals, Formative valuation	Liliana Guzmán (Fraunhofer IESE)
V1.0	31/07/2017	Summative Evaluation, Evaluation Plan	Liliana Guzmán (Fraunhofer IESE)



Authors	
Organisation	Fraunhofer IESE
Short name	Liliana Guzmán
Reviewers	
Organisation	First name last name
UPC	Claudia Ayala

Disclaimer

The work associated with this report has been carried out in accordance with the highest technical standards and the Q-Rapids partners have endeavoured to achieve the degree of accuracy and reliability appropriate to the work in question. However, since the partners have not control over the use to which the information contained within the report is to be put by any other party, any other such party shall be deemed to have satisfied itself as to the suitability and reliability of the information in relation to any use, purpose or application.

Under no circumstances will any of the partners, their servants, employees or agents accept any liability whatsoever arising out of any error or inaccuracy contained in this report (or any further consolidation, summary, publication or dissemination of the information contained within this report) and/or the connected work and disclaim all liability for any loss, damage, expenses, claims or infringement of third party rights.



Definition of the key terms and abbreviations	
A term or an abbreviation (alphabetical order)	Explanation of the term or the abbreviation



Contents

The list of tables	6
The list of figures	7
Executive summary.....	8
1. Introduction.....	9
1.1 Motivation	9
1.2 Intended audience.....	9
1.3 Scope	9
1.4 Relation to other deliverables	9
1.5 Structure of the deliverable	10
2. Object of study	11
3. The quality and impact of the Q-Rapids framework	15
4. Formative evaluation.....	21
4.1 Initial version of the framework.....	21
4.1 Consolidated version	23
5. Summative evaluation.....	25
Conclusion	26
References.....	27



The list of tables

Table 1: Overview of Q-Rapids process.....	11
Table 2: Overview of Quality-aware decision-making dashboard.....	12
Table 3: Overview of Strategic indicator model.....	13
Table 4: Overview of Prediction and Mitigation Techniques.....	13
Table 5: Overview of Q-Rapids data gathering and analysis tool.....	14
Table 6: Quality of the Q-Rapids framework.....	18
Table 7: Quality of the Q-Rapids components.....	19
Table 8: Expected impact of the Q-Rapids framework.....	20
Table 9: Formative Evaluation of the Q-Rapids process – Proof of concept.....	21
Table 10: Formative Evaluation of the Q-Rapids strategic dashboard and indicator model – Proof of concept.....	22
Table 11: Formative Evaluation of the data gathering and analysis tool – Proof of concept.....	22
Table 12: Formative Evaluation of the Q-Rapids process.....	23
Table 13: Formative Evaluation of the Q-Rapids strategic dashboard.....	23
Table 14: Formative Evaluation of the predictive and mitigation techniques.....	23
Table 15: Formative Evaluation of the data gathering and analysis tool.....	24



The list of figures

Figure 1: The Q-Rapids Framework 11



Executive summary

The Q-Rapids framework aims to provide the software industry with methods and tools for handling quality in the context of rapid software development (RSD). Q-Rapids relies on a generic data-driven, quality-aware, rapid development process characterised by integrated management of quality and functional requirements. Q-Rapids aims to be generic and suitable for managing the variety of quality requirements in different application domains and project settings.

To assess the impact of Q-Rapids framework, we designed a **formative evaluation** to evaluate iteratively the extent to which the Q-Rapids framework contributes to handling quality in the context of RSD. First, we plan to evaluate each Q-Rapids component by performing **structured focus groups** with the goal of obtaining early feedback on its quality and suggestions for improvements. Q-Rapids components comprises, e.g., the Q-Rapids process, strategic dashboard, strategic indicator model, prediction and mitigation techniques, and data gathering and analysis tool. We will focus on evaluating their information and system quality. Second, we will evaluate the proof-of-concept and the consolidated version of the Q-Rapids framework by performing **multiple-case studies** with the goal of obtaining feedback on its information and system quality and exploring its impact on key performance indicators (KPIs) such as productivity and time-to-market respectively.

Furthermore, we prepared a preliminary plan for the **summative evaluation** of the final Q-Rapids framework in real settings. The summative evaluation includes a **multiple-case study**, in which the Q-Rapids framework will be integrated into the industrial partners' development environments. We aim at investigating the quality of the Q-Rapids framework in terms of its information and system quality. We also aim at investigating to what extent the Q-Rapids framework affects the fulfilment of quality and functional requirements, the efficiency and effectiveness of the development process, the development and maintenance costs, and the time-to-market of software products.



1. Introduction

1.1 Motivation

The acceptance of the Q-Rapids framework by end-users depends on, amongst others, understanding its impacts and associated risks in different application domains and project settings. Thus, we plan a formative and summative evaluation. After defining the expected quality and impact of the Q-Rapids Framework from the perspective of research and practice in the deliverable D5.1 Industry requirements and validation plan, we designed empirical studies for performing the formative and summative evaluation (Task 5.2 Development of individual evaluation plans). This document encompasses:

- The object of studies: Overview of Q-Rapids components to be evaluated.
- Quality of the Q-Rapids Framework: Overview of the evaluation criteria for the Q-Rapids components and the entire Q-Rapids framework.
- Formative evaluation: Overview of the focus groups planned to evaluate the Q-Rapids components as well as of the multiple-case study planned to evaluate the proof-of-concept and consolidated version of the Q-Rapids framework.
- Summative evaluation: Overview of the multiple-case study planned to evaluate the final version of the Q-Rapids framework

The empirical designs presented here will be refined in collaboration with the research partners and tailored for each use case at the beginning of the next tasks (Task 5.3 – Task 5.6 Execution of the use cases). Moreover, the evaluation design presented here will be extended in next deliverables (D5.3 – D5.6 Evaluation of pilot cases)

1.2 Intended audience

This deliverable sets the general approach and plan to evaluate the Q-Rapids framework and its components during the project. It provides:

- All project partners as well as reviewers and PO with a common, specific, and pertinent definition of the expected quality of the Q-Rapids framework.
- The researchers of WP1 Data gathering and analysis architecture with the operationalisation of the quality of Q-Rapids data gathering and analysis tool.
- The researchers of WP2 Quality-aware Rapid Software Development Process with the operationalisation of the quality of Q-Rapids process.
- The researchers of WP3 Strategic Decision Making Dashboard with the operationalisation of the quality of Q-Rapids strategic dashboard, strategic indicator model, and prediction and mitigation techniques.
- The researchers of WP1, WP2, and WP3 with a evaluation methodology to get early feedback about the Q-Rapids components they are developing and to improve them iteratively.
- The Q-Rapids researchers with a preliminary evaluation methodology to assess the overall impact of the Q-Rapids framework in different application domains and settings.

1.3 Scope

The scope of this document is the full Q-Rapids project, in all its work packages and along its entire timeline.

1.4 Relation to other deliverables

In this document, we further specify and enhance the preliminary empirical design of the formative and summative evaluation reported in the deliverable D5.1 Industry requirements and validation plan.



1.5 Structure of the deliverable

This deliverable is organised into the following sections: in Section 2, we will provide an overview of the objects to be empirically evaluated during the Q-Rapids project. Then, we will briefly describe in Section 3 the expected quality and impact of the Q-Rapids framework and components. The evaluation goals will be selected and operationalized based on the expected quality and impact of the Q-Rapids framework. In Section 4, we will provide an overview of the planned empirical studies for the formative evaluation during the project phases “Initial version of the framework” and “Consolidated version.” Finally, we will provide an overview of the recommended strategy for performing the summative evaluation of the Q-Rapids framework.



2. Object of study

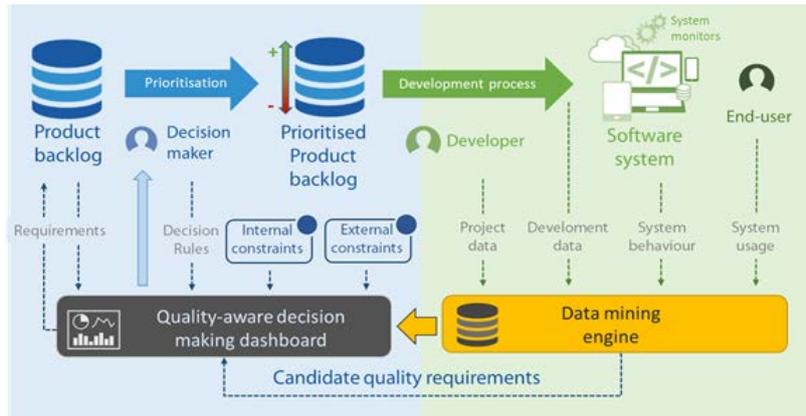


Figure 1: The Q-Rapids Framework

This deliverable addresses the evaluation of the Q-Rapids framework as a whole and its components. The Q-Rapids framework will include methods and tools for handling software quality in the context of rapid software development. To achieve this, the Q-Rapids framework relies on three main components (cf. Figure 1):

- **Q-Rapids process:** A generic data-driven, quality-aware, rapid development process characterised by integrated management of quality and functional requirements.
- **Q-Rapids strategic dashboard:** A strategic dashboard to support decision makers through a strategic indicator model, predictive techniques for the early identification of violations to the key strategic indicators, and mitigations techniques for analysing and comparing strategies for mitigating or avoiding violations to the key strategic indicators.
- **Q-Rapids data gathering and analysis tool:** A data gathering tool for integrating and cleaning data from heterogeneous data sources as well as a data mining engine for analysing heterogeneous project, development, and system usage data.

Table 1 to Table 5 provide a brief description of these Q-Rapids components and subcomponents in terms of its purpose, responsible work package, target users, existing alternatives, and planned development (status) during the Q-Rapids project phases.

Table 1: Overview of Q-Rapids process

Name	Q-Rapids process
Overview	Software life cycle integrating quality requirements and functional requirements.
Description	The Q-Rapids process will be defined including quality-aware practices, tools and methods to be used in rapid development cycles and complex scenarios. The foundation of the process will be based on agile and RSD and the key characteristics of these methods including the management of both functional and quality requirements using the holistic view of product backlogs, continuous integration and face-to-face interaction. The goal is to provide a generic Q-Rapids process, which can be customised based on the specific characteristic in the company and their quality demands. The Q-Rapids process will be a descriptive and flexible presentation of the process (i.e. including recommendations on how to setup a quality-aware process for the development of software products and services). It is expected that the concrete practices and methods will emerge during the life of the project.
Work package:	WP2



Target end-users:	Developers, product owners, scrum masters, and managers		
Alternatives:	State of the Art: None State of the practice: "as-is" process		
Planned development:	Project Phase	Status	Focus
	Initial version of the framework	Concept	Configuration of Q-Rapids framework, data gathering process as well as decision making process regarding to the strategic indicators <i>product quality</i> and <i>blocking</i> .
	Consolidated framework	Concept	
	Final version	Process	

Table 2: Overview of Quality-aware decision-making dashboard

Name	Q-Rapids strategic dashboard		
Overview	Strategic dashboard to support decision makers through strategic indicators.		
Description	<p>The quality-aware decision making dashboard will extend current tools such as SonarQube for measuring and analysing software quality (e.g., SonarQube™) by providing decisions makers with a highly informative dashboard to help them make data-driven strategic decisions related to quality requirements in rapid cycles.</p> <p>The dashboard will aggregate the data collected by work package WP1 Data gathering and analysis architecture into key strategic indicators related to, e.g., time to market, development costs, and overall quality. It will also comprise the product and iteration backlogs that contain the project requirements. Thus, the dashboard will help decision makers to analyse, e.g., the impact on time to market of selecting, leaving out, or discarding a quality requirement. In addition, the dashboard will allow defining project-specific decision rules (e.g., how to handle conflicts between time and quality levels) as well as external and internal constraints.</p>		
	<p>The Q-Rapids dashboard will provide models and advanced capabilities to</p> <ol style="list-style-type: none"> (1) Present decision-makers aggregated key indicators related to quality requirements in a concise, informative and friendly way. (2) Anticipate the violation of such key indicators along time by predicting violations based on the evolution of their value along time. (3) Offer elaborated techniques for exploring alternatives to be followed in the software development process based on their impact on the key indicators. (4) Suggest mitigation actions when violations or other type of deviations are predicted or detected. 		
Work package:	WP3		
Target end-users:	Product owners and managers, namely product and project managers		
Alternatives:	State of the Art: Third party tools State of the practice: Ad-hoc		
Planned development:	Project Phase	Status	Focus
	Initial version of the framework	Mock-ups and prototype	Strategic indicators: product quality and blocking
	Consolidated framework	Prototype	
	Final version	Prototype	



Table 3: Overview of Strategic indicator model

Name	Strategic indicator model														
Overview	Definition of a model that encompasses the indicators to be used in the Q-rapids framework.														
Description	The mission of this task is to convert the data gathered in WP1 from different sources into key indicators, which provide decision-makers with strategic information related to QRs. Decision-makers can use these indicators for different purposes: release planning, resource allocation, cost estimation, etc. To this end, a complex model will be built and consequently, it will be required to design the main constructs of the modelling language and the operational semantics that will implement computation rules.														
Work package:	WP3														
Target end-users:	Product owners and managers, namely product and project managers														
Alternatives:	State of the Art: None State of the practice: None														
Planned development:	<table border="1"> <thead> <tr> <th>Project Phase</th> <th>Status</th> <th>Focus</th> </tr> </thead> <tbody> <tr> <td>Initial version of the framework</td> <td>Model</td> <td>Strategic indicators: product quality and blocking</td> </tr> <tr> <td>Consolidated framework</td> <td>Final Model</td> <td></td> </tr> <tr> <td>Final version</td> <td>(Integrated in) Prototype</td> <td></td> </tr> </tbody> </table>			Project Phase	Status	Focus	Initial version of the framework	Model	Strategic indicators: product quality and blocking	Consolidated framework	Final Model		Final version	(Integrated in) Prototype	
Project Phase	Status	Focus													
Initial version of the framework	Model	Strategic indicators: product quality and blocking													
Consolidated framework	Final Model														
Final version	(Integrated in) Prototype														

Table 4: Overview of Prediction and Mitigation Techniques

Name	Prediction and mitigation techniques		
Overview	<i>Prediction techniques</i> are techniques aiming at predicting violations to the key indicators. <i>Mitigation techniques</i> refer to techniques aiming at supporting the analysis and comparison of different mitigation strategies, i.e., what-if-analyses.		
Description	<p><i>Prediction techniques:</i> The strategic dashboard will constantly monitor the state of the key indicators to predict their violation. Thresholds for the indicators will be defined using a service level agreement style; default contextual values will be suggested by default based on historical data. Violations will be clearly informed by the dashboard and their probability of occurrence will also be reported.</p> <p><i>Mitigation techniques:</i> The strategic dashboard will allow exploring different mitigation in the solution space through what-if-analysis.</p>		
Work package:	WP3		
Target end-users:	Product owners and managers, namely product and project managers		
Alternatives:	State of the Art: None State of the practice: Ad-hoc		



Planned development:	Project Phase	Status	Focus
	Initial version of the framework	---	----
	Consolidated framework	Concept	
	Final version	(Integrated in) Prototype	

Table 5: Overview of Q-Rapids data gathering and analysis tool

Name	Q-rapids data gathering and analysis tool		
Overview	A data gathering and analysis tool (i.e., Data mining engine) for analysing a heterogeneous project, development, and system usage data.		
Description	The Q-Rapids data gathering and analysis tool integrates heterogeneous data sources to provide integrated information about current quality issues from both the development and the actual system usage.		
Work package:	WP1		
Target end-users:	No direct end-users. The results of the data gathering and analysis tool will be used by the work package WP3 Strategic Decision Making Dashboard.		
Alternatives:	State of the Art: e.g., Jenkins, SonarQube, JIRA, Kibana State of the practice: "as-is" tools		
Planned development:	Project Phase	Status	Focus
	Initial version of the framework	Concept and prototype	Architecture; Data gathering tool
	Consolidated framework	Prototype	
	Final version	Prototype	



3. The quality and impact of the Q-Rapids framework

Evaluating the Q-Rapids framework as a whole as well as its components implies to assess them with regarding their quality and impact.

In [1], Vollmer (2016) systematically investigated the quality of systems for managing software quality. Based on the work of Vollmer (2016) [1] and the expectations of the end users of Q-Rapids on their quality, we decomposed the quality of the Q-Rapids framework into:

- **Information quality** refers to the quality of the data stored and produced within a system. Several operationalisations of information quality exist in the literature (e.g., [2] and [3]). After comparing, relating, and integrating existing definitions of information quality and the expectations of the end users of Q-Rapids, we defined the information quality of the Q-Rapids framework as the degree to which its data – stored or generated – are perceived by end-users as complete, current, relevant, reliable, understandable, and useful.
- **System quality** refers to the system's functionalities and the user experience in interacting with the system to perform specific tasks. In the literature, system quality has been defined by, e.g., McKinney et al. [2] and Nelson et al. [3]. After analysing existing operationalisations about system quality and comparing them with the expectations of the end users of Q-Rapids, we defined the system quality of the Q-Rapids framework as:
 - the degree to which its likely to achieve acceptance, and
 - the degree to which end-users perceived its functionalities and features as simple to integrate in their daily work, efficient, easy to navigate, relevant, reliable, and enjoyable.

Table 6 provides an overview of the definition of the quality of the Q-Rapids framework. Table 6: Quality of the Q-Rapids framework

Quality Aspect	Quality sub-aspect	Definition	Source ¹ [Frequency]
Information quality		It refers to the quality of the data stored or produced when using the Q-Rapids framework. It is the degree to which end-users perceive the information as ...:	R
	Completeness	... complete for providing enough breadth and depth for handling software quality in the context of rapid software development.	P, R
	Currency	... up-to-date for handling software quality in the context of rapid software development.	R
	Relevance	... applicable and helpful for handling software quality in the context of rapid software development.	P, R
	Reliability	... correct, accurate and trustworthy.	R
	Understandability	... as clear and understandable	P, R
	Usefulness	... informative, valuable and useful for handling software quality in the context of rapid software development.	P, R
System quality		It refers to functionalities for providing information and the user experience in interacting with Q-Rapids framework to handle software quality in the context of rapid software development. It is the degree to which end-users perceive ...	R
	Acceptance	... it as easy to use and useful for handling software quality in the context of rapid software development.	P, R



Complexity	... it as simple and easy to integrate with their daily work.	P
Efficiency	... it as efficient for handling software quality in the context of rapid software development.	P, R
Relevance	... its functionalities, features, and overall usage as relevant for handling software quality in the context of rapid software development.	R
Reliability	... it as accurate, dependable, and consistent.	P, R
Enjoyment	... the experience using it as satisfactory.	R
Navigation	...its navigation as easy (applicable only for prototypes or tools).	R
Visualization	... its visualisations as useful (applicable only for prototypes or tools).	R

¹P: One or more practitioners; R: One or more researchers



Table 7 maps the quality of the Q-Rapids framework to its components. We will operationalise each quality aspect and sub-aspect during the next project phases by tailoring and extending existing test instruments.

Based on the Q-Rapids project plan and the expectations of the end users of Q-Rapids on their impact, we expect to observe the impacts described in Table 8.



Table 6: Quality of the Q-Rapids framework

Quality Aspect	Quality sub-aspect	Definition	Source ¹ [Frequency]
Information quality		It refers to the quality of the data stored or produced when using the Q-Rapids framework. It is the degree to which end-users perceive the information as ...:	R
	Completeness	... complete for providing enough breadth and depth for handling software quality in the context of rapid software development.	P, R
	Currency	... up-to-date for handling software quality in the context of rapid software development.	R
	Relevance	... applicable and helpful for handling software quality in the context of rapid software development.	P, R
	Reliability	... correct, accurate and trustworthy.	R
	Understandability	... as clear and understandable	P, R
	Usefulness	... informative, valuable and useful for handling software quality in the context of rapid software development.	P, R
System quality		It refers to functionalities for providing information and the user experience in interacting with Q-Rapids framework to handle software quality in the context of rapid software development. It is the degree to which end-users perceive ...	R
	Acceptance	... it as easy to use and useful for handling software quality in the context of rapid software development.	P, R
	Complexity	... it as simple and easy to integrate with their daily work.	P
	Efficiency	... it as efficient for handling software quality in the context of rapid software development.	P, R
	Relevance	... its functionalities, features, and overall usage as relevant for handling software quality in the context of rapid software development.	R
	Reliability	... it as accurate, dependable, and consistent.	P, R
	Enjoyment	... the experience using it as satisfactory.	R
	Navigation	...its navigation as easy (applicable only for prototypes or tools).	R
	Visualization	... its visualisations as useful (applicable only for prototypes or tools).	R

¹P: One or more practitioners; R: One or more researchers



Table 7: Quality of the Q-Rapids components

Quality aspect	Quality sub-aspect	Q-Rapids component				
		Q-Rapids process	Q-Rapids strategic dashboard	Strategic indicator model	Prediction and mitigation techniques	Data gathering and analysis tool
		Quality of the data produced within the Q-Rapids process	Quality of the data stored and produced within the Q-Rapids strategic dashboard	Quality of the data included within the Q-Rapids indicator model	Quality of the data stored and produced by the prediction and mitigation techniques	Quality of the data stored and produced within the data gathering and analysis tool
Information quality	Completeness	X	X	X		
	Currency	X	X	X		
	Relevance	X	X	X		X
	Reliability	X	X	X		X
	Understandability	X	X	X		
	Usefulness	X	X	X		X
		Quality of the Q-rapids process and the user experience in using it		Quality of the Q-Rapids strategic dashboard and the user experience in interacting with it		
System quality	Acceptance	X	X	Not applicable		X
	Complexity	X		Not applicable		
	Efficiency	X		Not applicable		
	Relevance	X	X	Not applicable		X
	Reliability	X	X	Not applicable		X
	Enjoyment	X	X	Not applicable		
	Navigation	X	X	Not applicable		X
	Visualization	X	X	Not applicable		



Table 8: Expected impact of the Q-Rapids framework

Impact on ...	Indicator	Description	Project phase	Target value
Time to market	Feature throughput	Percentage of features that meet time to market with the desired levels of quality	Consolidated framework	N.A.
			Final version	+5%
	Release frequency	Number of features released per time unit	Consolidated framework	+5%
			Final version	+10%
Productivity	Productivity rate	Time used for development and test of new features / time used for maintenance or defect removal	Consolidated framework	+10%
			Final version	+15%
	Beta-testing time	Time from start to end dedicated to beta-testing (feature-specific)	Consolidated framework	-7%
			Final version	-15%
	Acceptance testing time	Time from start to end dedicated to acceptance test (feature-specific)	Consolidated framework	-5%
			Final version	-10%
Levels of quality	Customer satisfaction	Number of complaints after product release (e.g., from reviews, hot line, etc.)	Consolidated framework	-25%
			Final version	-70%
	Functional adequacy	Match of actual usage pattern to intended usage pattern (e.g., from log files)	Consolidated framework	+30%
			Final version	+75%
	Traceability level	Fraction of original quality requirements for which a traceability link is established all the way down to individual final features/release	Consolidated framework	+60%
			Final version	+85%
	Realized requirements	Fraction of quality requirements that are used in actual features and releases	Consolidated framework	+75%
			Final version	+85%
Functional requirements reuse	Functional requirements reuse	Percentage of functional requirements that appear in subsequent releases of a product	Consolidated framework	+5%
			Final version	+10%



4. Formative evaluation

The formative evaluation aims to evaluate the Q-Rapids as a whole and its components. In Section 4.1, we will summarize the planned empirical evaluations during the project phase “Initial version of the framework”. In Section 4.2, we will provide an overview of the recommended formative evaluation for the project phase “Consolidated framework.” At the beginning of each project phase, we will discuss the suggested methodological approaches with the developers of each component, select the most appropriate one, and design the corresponding evaluation package.

The procedures, instruments, and materials used in each empirical study are been documented in separated documents using standardized templates, which serve as basis for performing each study as well as for reporting and disseminating results.

4.1 Initial version of the framework

Table 9: Formative Evaluation of the Q-Rapids process – Proof of concept

Component	Q-Rapids process
Project phase	Initial version of the framework
Planned status	Concept
Focus	Configuration of Q-Rapids framework, data gathering process as well as decision making process regarding to the strategic indicators product quality and blocking.
Evaluation goal	<p>Characterize the notation used for specifying the Q-Rapids process with respect to its understandability, locatability, and completeness from the perspective of its end-users in the context of rapid software development.</p> <p><i>Characterize the Q-Rapids process with respect to its understandability, usefulness and completeness as well as its compatibility with existing processes <i>from the perspective of its end-users in the context of rapid software development.</i></i></p>
Target population	Practitioners of the four use cases including the responsible persons for configuring and installing the Q-Rapids framework as well as decision makers (i.e., product owners)
Planned studies	<p><u>Study 1 – Preliminary version of the process specification</u> Focus group including: (1) introduction to the evaluation goals and procedures (2) introduction to the notation and Q-Rapids process presentation of the process, (3) structured feedback questionnaire on the quality of the notation and Q-Rapids process, (4) open feedback on the strengths and drawbacks of the Q-Rapids process as well as creativity session to identify concrete improvements.</p> <p>Timeline: September – October 2017</p> <p><u>Study 2 – Preliminary Version of the process</u> Focus group including: (1) presentation of the process, (2) structured feedback questionnaire on the quality of the Q-Rapids process, (3) open feedback on the strengths and drawbacks of the Q-Rapids process, and (4) (optional) creativity session to identify concrete improvements.</p> <p>Timeline: December 2017</p>



Table 10: Formative Evaluation of the Q-Rapids strategic dashboard and indicator model – Proof of concept

Component	Q-Rapids strategic dashboard and indicator model
Project phase	Initial version of the framework
Planned status	Mock-ups; Prototype
Focus	Strategic indicators: product quality and blocking
Evaluation goal	<p>Characterize the mock-ups/prototype of Q-Rapids strategic dashboard with respect to its usefulness, ease of use, visualizations, navigation, and relevance from the perspective of its end-users in the context of rapid software development.</p> <p>Characterize the definition of Q-Rapids strategic indicators product quality and blocking with respect to its understandability, reliability, usefulness, completeness and relevance from the perspective of its end-users in the context of rapid software development.</p>
Target population	Practitioners of four use cases including developers and product owners
Planned studies	<p><u>Study 1 – Mock-ups and blocking definition</u> Online focus group including: (1) introduction to the evaluation goals and procedures, (2) presentation of the mock-ups of Q-Rapids strategic dashboard and blocking definition, (3) structured feedback questionnaire on the quality of the mock-ups and blocking definition, (3) open feedback on the strengths and drawbacks of the Q-Rapids strategic dashboard using the online tool Six Steps, and (4) (if appropriate) creativity session to identify concrete improvements.</p> <p>Timeline: June – July 2017</p> <p><u>Study 2 – First prototype</u> Focus group including: (1) introduction to the evaluation goals and procedures, (2) introduction to the prototype of the Q-Rapids strategic dashboard, (3) exploration of the Q-Rapids strategic dashboard and resolution of tasks, (4) and structured feedback questionnaire on the quality of the mock-ups and blocking definition.</p> <p>Timeline: September – October 2017</p> <p><u>Study 3 – Proof of concept</u> Case study in controlled environment including: (1) introduction to the evaluation goals and procedures, (2) training to Q-Rapids strategic dashboard, (3) task resolution including observation, (4) feedback questionnaire on the quality of the Q-Rapids strategic dashboard and strategic indicators, and (5) retrospective session on the strengths and drawbacks of the Q-Rapids process.</p> <p>Timeline: December 2017</p>

Table 11: Formative Evaluation of the data gathering and analysis tool – Proof of concept

Component	Data gathering and analysis tool
Project phase	Initial version of the framework
Planned status	Concept/Prototype
Focus	Quality model related to the strategic indicators product quality and blocking
Evaluation goal	Characterise the data gathering tool with respect to its information quality (i.e., relevance) and system quality (i.e., relevance) from the perspective of its end-users in the context of rapid software development.
Target population	Practitioners of four use cases including product owners



Methodological approach (proposal)	<p><u>Study 1 – Proof of concept (integrated version with the Q-rapids strategic dashboard)</u></p> <p>Case study in controlled environment including: (1) introduction to the evaluation goals and procedures, (2) training to Q-Rapids strategic dashboard, (3) task resolution including observation, (4) feedback questionnaire on the quality of the Q-Rapids strategic dashboard, strategic indicators, and quality model, and (5) retrospective session on the strengths and drawbacks of the Q-Rapids process</p> <p>Timeline: December 2017</p>
---	--

4.1 Consolidated version

Table 12: Formative Evaluation of the Q-Rapids process

Component	Q-Rapids process
Project phase	Consolidated framework
Expected status	Concept
Evaluation goal	Compare the Q-Rapids process with the “as-is” situation with respect to its information quality and process quality (i.e., acceptance, complexity, efficiency, relevance, reliability, and enjoyment) from the perspective of its end-users in the context of Q-Rapids’ use cases.
Target population	Practitioners of four use cases
Methodological approach (proposal)	Case study or experiment including: (1) Training to process or specific sub-processes, (2) task resolution according to the selected process including observation, (3) feedback questionnaire on the quality of the Q-Rapids process, and (4) retrospective session on the strengths and drawbacks of the Q-Rapids process.

Table 13: Formative Evaluation of the Q-Rapids strategic dashboard

Component	Q-Rapids strategic dashboard
Project phase	Consolidated framework
Expected status	Prototype
Evaluation goal	Compare the Q-Rapids strategic dashboard with the “as-is” situation with respect to its information quality and system quality (i.e., acceptance, efficiency, relevance, reliability, enjoyment, navigation, and visualization) from the perspective of its end-users in the context of Q-Rapids’ use cases.
Target population	Practitioners of four use cases
Methodological approach (proposal)	Case study or experiment design including: (1) training to Q-Rapids strategic dashboard, (2) task resolution including observation, (3) feedback questionnaire on the quality of the Q-Rapids strategic dashboard, and (4) retrospective session on the strengths and drawbacks of the Q-Rapids process.

Table 14: Formative Evaluation of the predictive and mitigation techniques

Component	Q-Rapids the predictive and mitigation techniques
Project phases	Consolidated framework
Expected status	Prototype
Evaluation goal	Evaluate the prediction and mitigation techniques with respect to its information quality from the perspective of its end-users in the context of rapid software development.



Target population	Practitioners of four use cases
Methodological approach (proposal)	<p><u>Alternative 1:</u> Group interview including: (1) presentation of the prediction and mitigation techniques, (2) (if appropriate) user exploration or task resolution, (3) structured feedback questionnaire on the quality of the, the prediction and mitigation techniques, and (3) open feedback on the strengths and drawbacks of the prediction and mitigation techniques.</p> <p><u>Alternative 2:</u> Case study or experiment including: (1) training to the prediction and mitigation techniques, (2) task resolution including observation, (3) feedback questionnaire on the quality of the prediction and mitigation techniques, and (4) retrospective session on the strengths and drawbacks of the prediction and mitigation techniques.</p> <p><u>Alternative 3:</u> Retrospective or prospective case study: Comparing the results of the predictive technique with actual data, e.g., historical data collected in advance or after using the predictive technique at one point in time of the project related to the use case.</p>

Table 15: Formative Evaluation of the data gathering and analysis tool

Component	Data gathering and analysis tool
Project phase	Consolidated framework
Expected status	Prototype
Evaluation goal	<p><i>Characterise the data gathering and analysis tool with respect to its information quality (i.e., relevance and usefulness) and system quality (i.e., acceptance, relevance, and navigation) from the perspective of its end-users in the context of rapid software development.</i></p>
Target population	Practitioners of four use cases
Methodological approach (proposal)	Case study or experiment including: (1) training to data gathering and analysis tool, (2) task resolution including observation, (3) feedback questionnaire on the quality of the data gathering and analysis tool, and (4) retrospective session on the strengths and drawbacks of the data gathering and analysis tool.



5. Summative evaluation

The summative evaluation aims to evaluate the (ready-to-integrate) components and the whole Q-Rapids framework in real settings during the project phase “Final version”. Thus, the summative evaluation will be conducted as case studies in which end-users will use the Q-Rapids framework for managing software quality in the context of the selected use cases. The evaluation goals of the summative evaluation include:

- Characterising the **Q-Rapids framework** with respect to its **information and system quality**.
- Characterising the **Q-Rapids process, strategic dashboard, and data gathering and analysis tool** with respect to its **information and system quality**
- Evaluate the **Q-Rapids framework** with respect to the **expected impacts** described in Table 8.
- Evaluate the **Q-Rapids framework** with respect to its **impact on the quality of software products**. That is, the degree to which a software product fulfils quality and functional requirements when using the Q-Rapids framework.
- Evaluate the **Q-Rapids framework** with respect to its **impact on the efficiency and effectiveness of the software development process**. That is, the effort required for managing software quality and the degree to which deviations from quality requirements can be avoided or mitigated.
- Explore the **Q-Rapids framework** with respect to its impact on time to market and development and maintenance costs.



Conclusion

In this deliverable, we summarise:

- The validation design for the project phase “Initial version of the framework!” in terms of the Q-Rapids components to be evaluated, the preliminary operationalization of the quality of the Q-Rapids framework and its components, and the evaluation strategy for the formative evaluation.
- The preliminary validation plan for the formative evaluation during the project phase “Consolidated framework”
- The preliminary validation plan for the summative evaluation

These results enable the execution of the formative evaluation during the next project phase “Proof-of-concept.”



References

- [1] S. Kvale, *Doing Interviews*, Sage Qualitative Research Kit Series, London: SAGE Publications Ltd., 2009.
- [2] V. Basili, A. Trendowicz, M. Kowalczyk, J. Heidrich, C. Seaman, J. Münch and D. Rombach, *Aligning Organizations Through Measurement - The GQM+Strategies Approach*, Springer Verlag, 2014.
- [3] S. Wagner and A. e. a. Goeb, "Operationalised product quality models and assessment: The Quamoco approach.," *Information and Software Technology*, vol. 62, pp. 101-123, 2015.
- [4] V. Basili, G. G. Caldiera and H. Rombach, "The Goal Question Metric Approach," in *Encycl. Softw. Eng.*, Wiley, 1994.
- [5] D. Dillman, J. Smyth and L. Christian, *Mail and Internet Surveys: The Tailored Design Method.*, 3rd ed., New York: John Wiley and Sons, 2009.
- [6] A. Vollmer, "Empirical evaluation of the prodebt approach (Master's thesis)," Technical University of Kaiserslautern, 2016.
- [7] V. McKinney, K. Yoon and F. M. Zahedi, "The measurement of web- customer satisfaction: An expectation and disconfirmation approach," *Information Systems Research*, vol. 13, no. 3, p. 296–315, 2002.
- [8] R. Nelson, R. R. Todd and B. H. Wixom, "Antecedents of information and system quality: An empirical examination within the context of data warehousing," *Journal of Management Information Systems*, vol. 214, pp. 199-235, 2005.

