Deliverable 2.1

Project deliverable D2.1

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1.1 Legal Disclaimer

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2 Project Executive Summary

SCALE (Smart Charging Alignment for Europe) is a three-year Horizon Europe project that aims at preparing EU cities for mass deployment of electric vehicles and the accompanying smart charging infrastructure.

Charging electric vehicles (EVs) predominantly occurs in residential areas and business districts, as well as on public streets. This arrangement presents significant opportunities for smart charging and vehicle-to-everything (V2X) functionalities. By making charging more accessible and user-friendly, it can drive greater adoption of EVs. Additionally, this setup encourages the use of locally produced renewable energy, thereby enhancing the use of sustainable power sources and reducing reliance on the grid.

3 SCALE partners

List of participating cities:

- Oslo (NO)
- Rotterdam & Utrecht (NL)
- Eindhoven (NL)
- Toulouse (FR)
- Greater Munich Area (GER)
- Budapest & Debrecen (HU)
- Gothenburg (SE)

List of partners:

- (Coordinator) STICHTING ELAAD NL
- POLIS - PROMOTION OF OPERATIONAL LINKS WITH INTEGRATED SERVICES, ASSOCIATION INTERNATIONALE POLIS BE
- GoodMoovs NL
- Rupprecht Consult – Forschung & Beratung GmbH RC DE
- Trialog FR
- WE DRIVE SOLAR NL BV NL
- UNIVERSITEIT UTRECHT NL
- LEW Verteilnetz GmbH DE
- BAYERN INNOVATIV - BAYERISCHE GESELLSCHAFT FUR INNOVATION UND WISSENSTRANSFER MBH DE
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4 Deliverable executive summary

This Deliverable falls under the SCALE Project Work Package 2 “Development of Smart Charging and V2X Technologies and Solutions” and specifically under the Task 2.1 “Risk analysis of the new developments”. It is a purely technical document that targets to support the efficient monitoring of the technical developments within WP2.

The current version is the finalized document that synthesizes information collected and consolidated through a two-step process. The first phase, covering up to Month 12 (M12), includes preliminary data gathered prior to the development of the systems or modules. The second phase, extending to Month 30 (M30), incorporates identified risks following the installation of the technologies.

4.1 Keywords

Risk analysis, risk mitigation, overall risk number, risk severity, risk occurrence, risk detectability, risk recoverability, technical risks, behavioural risks, legal risks, organisational risks.

4.2 Document aim

The aim of this deliverable is to present the early identification of potential risks and issues that the consortium anticipated may arise during the design and development of smart charging and V2X technologies and solutions. The findings from this initial phase have already informed the technical partners involved in the development of Work Packages 2, 3, 4, and 5.

Additionally, the second stage of the deliverable outlines the risks encountered following the technological installations and pilots demonstrations, along with newly identified risks that emerged after M12 that were not initially predicted.

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5 List of abbreviations and acronyms

Acronym	Meaning
FMEA	Failure Mode and Effects Analysis
D	Detectability
O	Occurrence
R	Recoverability
S	Severity
V2G	Vehicle to Grid
WP	Work Package
OCPP	Open Charge Point Protocol
KPI	Key Performance Indicator

6 Introduction

In general, it's very usual for any new technical advancement to exhibit some sort of flaws or mistakes, especially in the first phases of research, design, and specification. The costs of fixing a product vulnerability during the system testing phase or after the product is in use will likely be higher and more complex than if the problem was fixed during the design phase, so it is very important to identify on-time possible problematic areas. However, these problems can be overcome if they are predicted and detected at an early stage.

The following diagram shows the lifetime of a system or service, from the analysis and design stages to its development and marketization. For an innovation that is created as part of a research study, there are six basic stages, and there are two additional when dealing with a marketable product.

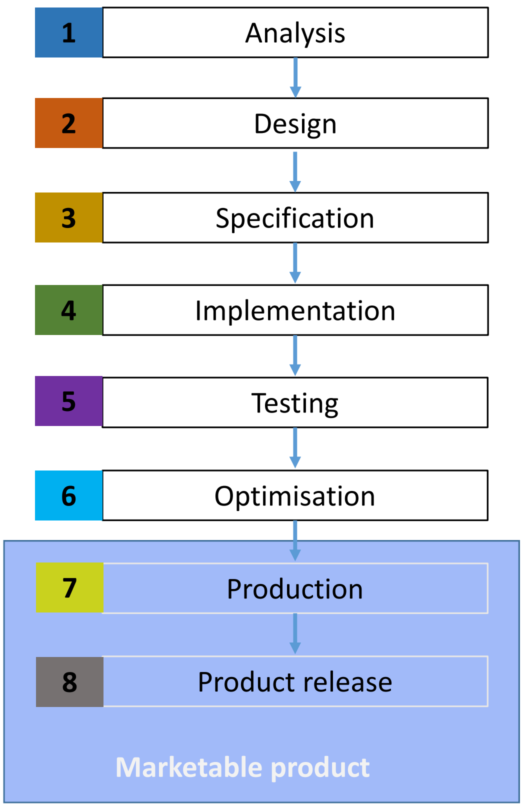

Figure 1: Product development lifecycle

In this document, the risk assessment methodology that will be followed in SCALE is described and the accompanied results are presented. The goal was to identify potential risks and issues as early as feasible in the project's design and development of smart charging and V2G technologies and solutions and then in M30 to see what was indeed happened and if there was any new risk that was not foreseen. The project went through two phases of risk analysis.: In phase1, the a priori risks identified, due on Month 12, while in phase 2, the posteriori risks are reported (Month 30).

Various potential malfunctions can occur within the system, but it is essential to highlight the most significant causes, which include:

a. errors or compatibility issues at the system or subsystem level

b. incorrect usage by users, particularly in relation to human-machine interaction (HMI)

c. barriers within the organization that impede effectiveness

d. legal constraints that restrict functionality

For the first type of problem, the developers of SCALE solutions had put more effort to fix the possible problems, while for the second one, the users personal limits were the main concern. The third type refers to the structure of the involved companies or stakeholders and how it is affected, while the last one required system/solutions adaptation to local, national or international law or standardization activities.

Risks can be avoided, transferred, softened, solved or else accepted. The Risk Analysis results indicate possible and actual problematic areas in which the system developers were called to put more effort on (i.e. to offer mitigation strategies).

7 Risk analysis methodology

A risk analysis must follow an effective and clear stepwise procedure in order to be successful. In SCALE project we will follow the Failure Modes, Effects and Criticality Analysis (FMEA / FMECA), in order to identify the potential system risks and also propose adequate mitigation solutions. More specifically, the extended FMEA methodology will be applied here, developed within the ADVISORS project (Bekiaris & Stevens 2005), which is based on FMEA, but includes the indicators of *hazard consequence severity, occurrence probability, detectability* and *recoverability*, and extends the typical FMEA methodology by covering not only technical risks, as done in FMEA, but also behavioral, legal and organizational – related risks.

The Failure Mode and Effects Analysis (FMEA) is a methodology designed to:

- Recognize potential product, service, or process failure modes.
- Assess the risk associated with those failure modes and prioritize issues for corrective actions.
- Identify the most crucial issues and take appropriate corrective action.

There are many ways that the FMEA helps with Risk Management (https://fmea-training.com):

- It begins by offering a framework for creating a thorough list of potential risks.

1. It assists with evaluation of those risks in terms of how severe they could be, their likelihood of occurring and the chance the potential failure has to be detected before failure.
2. It is a tool to decide which are the most serious risks.
3. It helps pointing ways to reduce the most serious risks.
4. It enables reevaluation to determine if the risk has been sufficiently reduced or if more work needs to be done.

In SCALE, the risks analysis work took place in two phases:

- Phase 1: estimation of a *priori/foreseen risks*, along with mitigation/alternative solutions (due on Month 12).
- Phase 2: *a posteriori risks* analysis, in order to identify *actual & unforeseen risks* that occurred after the project developments and examine the compensation solutions that were applied (due on Month 30).

Such an analysis involves various factors of each safety-security issue: severity, occurrence probability, detectability and recoverability, not only for technical risks, but also for behavioral, legal and organizational related risks. Summarizing, the four risks categories are explained as follows:

- **Technical and interoperability** - dealing with the new system or its sub-elements (hardware and software) functionalities, their (future) technological limitations and possible failures or complications with other components; these are related to the technical maturity of the solution.
- **Behavioral** – related to HMI and human error, i.e. the user's behavior, regarding their interaction with the system, concentrating on the possible unexpected/erroneous actions.
- **Legal** - in relation to the possible legislative compliance or conflicts in various EU countries where the system is planned to be introduced.

- **Organizational/ operational -** risks involved within the organization structure of the involved actors and stakeholders' companies or the road electrification sector, their current procedures, shift of work times, etc.

Although the risks categories were clear, many of these risks were intricately were inherently interrelated to one another.

The FMEA procedure is a flexible tool that has been adapted for a variety of uses, including the design and development stages for products, services, and processes. As a result, higher reliability, higher quality, increased safety, increased customer satisfaction, and lower costs have been achieved. An FMEA is often required to comply with safety and quality requirements, such as ISO 9001, QS 9000, ISO/TS 16949, Six Sigma, FDA Good Manufacturing Practices (GMPs), Process Safety Management Act (PSM), etc. The overall process proposed by the extended FMEA methodology is summarized in **Error! Reference source not found.** below. As mentioned earlier, it includes different types of risks (technical, behavioral, legal and organizational/ operational); some of these risks may be interrelated, meaning that one can affect or even produce the other. As it is depicted in the diagram below, FMEA is only the first part of the process which deals with technical and interoperability related risks, while the rest of the boxes are part of the extended FMEA methodology.

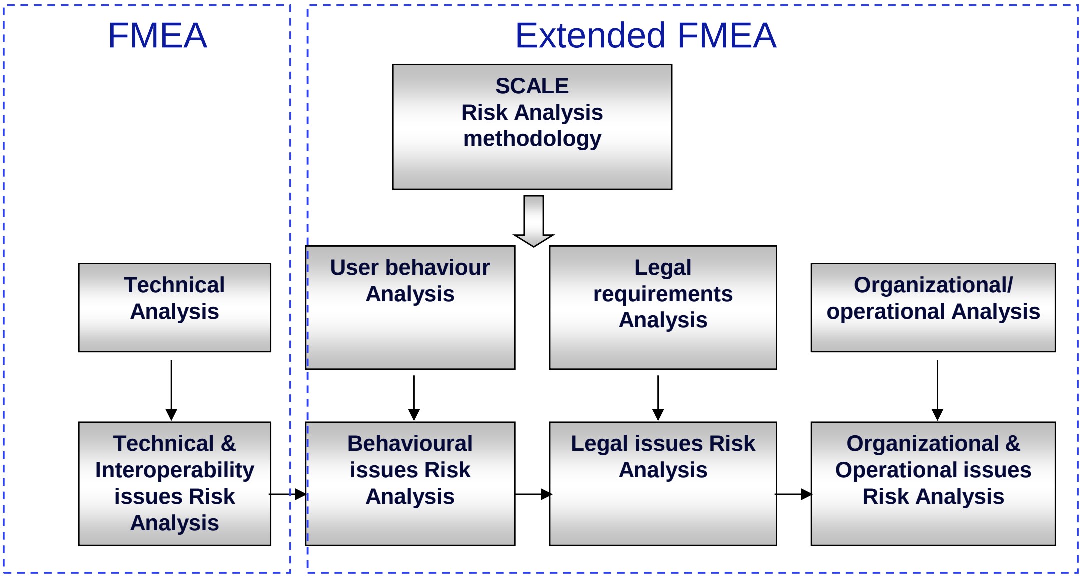

Figure 2: Risk analysis process.

The Risk number (for each risk) was calculated using the following equation:

$$\boxed{RN = S \times O \times \frac{D+R}{2}} \qquad (1)$$

Where:

S=Severity

O=Occurrence probability

D=Detectabilty

R=Recoverability

Each of the above factors can be measured using the tables below. In these tables, the levels of severity, occurrence, detectability and recoverability for each type of risk are explained.

Level of severity	Technical issue	Behavioral issue	Legal issues	Organizational issues
9-10 (extremely severe)	The failure could put user safety at risk.	The user error in operating the system could lead to an incident worsens (i.e. safety effects).	Are there laws in each country that do not allow the system to be implemented?	Wide and different organizational framework is needed, that is completely missing (i.e. new services).
7-8 (severe)	The failure implies the total loss of the system functions, resulting in user's dissatisfaction.	User behavioral error may abort the system benefits (i.e. safety effects due to changes in ways of acquiring info).	For system implementation, new laws are necessary, but no pertinent work has been done yet.	Organizational framework adaptation is needed (some initial actions have been taken on this domain).
5-6 (slightly severe)	The failure implies the partial loss of the system function, resulting in user's dissatisfaction.	User's behavioral changes may significantly reduce the positive effects of the system.	New laws are required for system implementation and work required has already been performed.	Organizational framework adaptation is needed which has already started being realized.
3-4 (significant)	The failure implies slight dissatisfaction to the user.	User's behavioral changes may somehow influence the positive effects of the system.	New laws are required for system implementation but consensus on them exist.	There is a need for limited and easily realized organizational changes.
1-2 (insignifican t)	Failure does not imply noticeable effects on how well the system works or how	User's behavior is not expected to reduce the system benefits significantly, or	No new laws are required for implementation.	There is no need at all for organizational changes.

Level of severity	Technical issue	Behavioral issue	Legal issues	Organizational issues
	satisfied the user is.	may even further enhance them.		

Table 1: Severity level analysis.

Occurrence level	Technical issue	Behavioural issue	Legal issues	Organisational issue
9-10 **(high)**	It is certain that some failures will sometimes occur.	It is certain that some behavioral effects will occur (by the system users).	It is certain that some legal problems will occur.	It is certain that there will be a need for organizational restructuring.
6-8 **(medium)**	A failure could occasionally occur.	Some behavioral effects could occasionally occur.	Some legal problems could occasionally occur.	A need for organizational restructuring could occasionally occur (depending on the needs of the service that will arise after the operation of the system).
3-5 **(slight)**	There is only a slight probability that an error/failure will occur.	There is only a slight probability that some behavioral effects will occur.	There is only a slight probability that some legal problems will occur.	There is a very low chance that organizational restructuring will be necessary.
1-2 (improbable)	It is unlikely that a fault will occur.	It is unlikely that some behavioral effects will occur.	It is unlikely that some legal problems will occur.	It is unlikely that a need for organizational restructuring will occur.

Table 2: Occurrence level analysis.

Detectability level	Technical issue	Behavioral issue	Legal issue	Organizational issue
9-10 **(improbable)**	It is impossible or improbable that a problematic area will be detected.	It is impossible or improbable that a user's behavioral effect will be detected.	It is impossible or improbable that a legal problem will be detected.	It is impossible or improbable that an organizational problem will be detected.
7-8 **(slight)**	The problematic area is detected only in particular cases.	The user's behavioral effect is detected only in particular cases.	The legal problem is detected only in particular cases.	The organizational problem is detected only in particular cases.
5-6 **(moderate)**	It is probable that the problem will be detected (depending on the situation).	It is probable that the user's behavioral effect will be detected.	It is probable that the legal problem will be detected.	It is probable that the organizational problem will be detected.
3-4 **(high)**	It is very probable that a problem will be detected.	It is very probable that the user's behavioral effect will be detected.	It is very probable that the legal problem will be detected.	It is very probable that the organizational problem will be detected.
1-2 **(very high)**	It is certain that a problem will be detected.	It is certain that the user's behavioral effect will be detected.	It is certain that the legal problem will be detected.	It is certain that the organizational problem will be detected.

Table 3: Detectability level analysis.

Recoverability level	Technical issue	Behavioral issue	Legal issues	Organizational issues
9-10 **(null)**	No recovery action is provided.	System is inflexible to user's behavioral effects.	System is either accepted or rejected by	System requires a fixed organizational environment to operate.

Recoverability level	Technical issue	Behavioral issue	Legal issues	Organizational issues
			the legal framework.	
6-8 **(low)**	The user is only advised on the failure.	Behavioral effects are taken into account by the system.	System may be slightly adapted to meet legal restrictions.	System requires a fixed organizational framework with limited adaptations.
3-5 **(high)**	Effective recovery action is provided.	System customization might compensate for user's behavioral effects.	System encompasses different versions to meet particular legal demands.	System may operate within various organizational frameworks.
1-2 **(full recoverability)**	The failure effect is completely avoided by the recovery action.	System does not allow user's behavioral effects.	System is easily reconfigurable to meet legal demands.	System does not require organizational changes.

Table 4: Recoverability level analysis.

7.1 Risks severity and mitigation possibility

The total risk that was calculated is matched to five levels of severity (with which should be filled in the 'Problem severity" column of the above table), as follows:

Overall risk factor	Overall severity
512-1000	I- Extremely severe
216-512	II- Severe
64-216	III - Moderate
8-64	IV - Slight
1-8	V - Insignificant

Table 5: Correlation of the Risk Number with the overall risk Severity level.

Then, according to the severity level, the mitigation possibility can be defined as follows. This indicates the possibility of a successful corrective strategy (over a 10-year horizon).

Risk/issue severity	Mitigation possibility
Extremely severe	
Severe	High
Moderate	Medium
Slight	Low
Insignificant	Improbable

Table 6: Severity and mitigation possibility scales.

Risk reduction is an iterative process involving dependencies between the different issues. In terms of mitigation strategies, a problem can be eliminated in a number of generic ways:

- reducing the magnitude (severity) of the consequences of the potential risk;
- reducing the probability occurrence of the risk;
- increasing risk detection speed and probability;
- protecting against the risk - countermeasures to compensate for a failure (e.g. back-up solutions).

The exact definitions of what is actually meant by the mitigation possibility are provided, according to the different levels of possibility.

Possibility of mitigation (10 year horizon)	Definition
High	A solution is available at relatively low cost.
Medium	An achievable solution may be possible at reasonable cost, or a reasonable solution is available at modest cost.
Low	An expensive solution may be possible, but system benefits may not justify these, and/or a solution needs further investigation or is highly complicated.
Improbable	Solutions are too expensive (likely to remain so) in relation to the reduction of risk(s) and the benefits gained from the functionality of the system, and/or a solution is not available for the (extremely) severe risk that has been identified

Table 7: Failure mitigation possibility levels and their definition

7.2 Risks analysis template

In order for the results of the Risk analysis to be comparable and mainly presented in a comprehensive format and understandable way, an excel template was created and distributed to the WP2, 3, 4 and 5 partners. Into this excel file the main risks identified, were summarized according to the following common format and assigned to an overall risk rating, based on which the risk severity and mitigation possibility was defined. The template distributed is presented in Table 8.

Risk type* (select one)	Relevant project task	Problem short description *	S*	O*	D*	R*	Risk Number	Risk severity	Mitigation strategy*
❑Technical ❑Behavioural ❑Legal ❑Organizational									

Table 8 Detailed Risk analysis template, including mitigation strategy

8 Results

8.1 First Phase Results (M12)

The template presented in Table 8 was used to gather the risks/problems identified in the initial stage of the project and before the system has been developed and tested. Input has been provided by the partners working on WP2, 3, 4 and 5.

Overall, 23 risks have been gathered during the first phase of the risk analysis task, which are divided per type and are presented in the following tables. As expected, the majority of the foreseen risks relate to technical and interoperability issues, while there are 5 operational risks identified, 2 are behavioural and 1 is legal. These are presented below from Table 12 to Table 9.

Relevant project Task	Problem short description	S	O	D	R	Risk Number	Risk severity	Mitigation strategy
T1.5 T2.2 T2.4	Scope not correctly defined in terms of development/ testing/ integration phase	5	3	6	5	82,5	III - Moderate	Scope guarding and re-iterations if needed
T2.4	V2G CCS ISO 15118-20 charger development not ready in time	8	5	2	4	120	III - Moderate	a) Buy replacement from other source. b) Accept delay & initially test features using only scheduled charging instead of V2G
T2.4	2. Standardization readiness: The ISO 15118-20 is released for the communication protocol, but there is no standard to define the electrical requirements of the charger itself. Therefore, there is no guideline how to develop a bidirectional charger, which might lead to fundamental design issues that are difficult to resolve.	5	5	1	5	75	III - Moderate	Push for the standard. If necessary, work based on preliminary standards.

Relevant project Task	Problem short description	S	O	D	R	Risk Number	Risk severity	Mitigation strategy
T2.4	Assets cannot be integrated with each other, not supporting the correct protocols/standards/grid compliancy etc. This will be discovered in a later phase	7	4	3	6	126	III - Moderate	Search for additional HW that can be a "translation" between the existing HW
T2.5	Interoperability issues	6	6	6	4	180	III - Moderate	a) Fix the issues. b) Perform pre-tests early to detect issues early
T2.6	The introduction of EV Chargers can cause the undesirable drops to the Network Voltage when the chargers are on charge mode (V1G) or undesirable raises when they are on discharge mode (V2G).	8	4	7	5	192	III - Moderate	The Tool of task 2.6 operates by the setting the voltage on every Network Bus as a constrain where the value must lie between two limits, predetermined by DSO.
T2.6	The introduction of EV Chargers can cause the undesirable raises to the Network's Line Currents, especially when they are on charge mode (V1G).	8	4	7	5	192	III - Moderate	The Tool of task 2.6 operates by the setting the current on every Network Line as a constraint where the value must be, at least equal to the Nominal Line Current.
T2.6	After the introduction of the EV Charger or Chargers to a Network bus, the total Apparent Power of the bus can overcome the Nominal	9	4	9	5	252	II - Severe	The Tool of task 2.6 operates by the setting the apparent on every Network Bus as a contain where the value must be, at least, equal to the

Relevant project Task	Problem short description	S	O	D	R	Risk Number	Risk severity	Mitigation strategy
	Apparent Power, overloading the bus.							Nominal Bus Apparent Power.
T2.6	When the consumptions of Network's Loads are peaked, The EV Chargers can negatively affect the overall Network Congestion and Power Losses.	6	7	7	3	210	III - Moderate	The Tool of task 2.6 places the EV chargers on Network Buses optimally, in order to mitigate the Network Congestion and Power Losses.
T4.2	Not all KPI's (correctly) defined	5	3	6	7	97,5	III - Moderate	Redefine and recalculate the outcomes/findings
T4.2	Validation not possible due to lacking data and/or data gaps	4	5	8	5	130	III - Moderate	Redefine measurement strategy/equipment
T5.2	Voltage impacts, where the magnitude of every bus voltage is lower than a low limit during the charging (V1G mode) and greater during discharging (V2G or V2X mode).	8	6	5	5	240	II - Severe	Development of a tool to ensure that the voltage magnitudes remains beneath their permitted limits.
T5.2	Current impacts, where the current one or more lines surpasses the nominal current of the current of the line. This impact is caused mainly during charging when the energy demand of the Network is peaked, but also can be caused during discharging if the discharging power is uncontrollably.	8	6	5	5	240	II - Severe	Development of a tool to ensure that the current remains below the nominal values. This ensures the fulfillment of the congestion impacts as well.

Relevant project Task	Problem short description	S	O	D	R	Risk Number	Risk severity	Mitigation strategy
T5.2	Stability impacts, where the angle of every bus voltage is out of the specific Network's limits.	8	6	5	5	240	II - Severe	Development of a tool to ensure that the voltage angles remains beneath their permitted limits.
T5.2	Network saturation, where EV charge station (with V2G or V2X capabilities) enhances the short circuit current so much so that no other EV charge station (with V2G or V2X capabilities) or DER can be installed in the close area.	9	6	6	5	297	II - Severe	Development of a tool which takes into account the already existing Network saturation and places the EV charging station in locations where the saturation is negligible

Table 9 Technical and Interoperability issues related risks

Relevant project Task	Problem short description	S	O	D	R	Risk Number	Risk severity	Mitigation strategy
T3.1	Deployment of hardware doesn't work out (e.g. connection to grid leads to extra cost or delays)	8	5	3	6	180	III - Moderate	a) Try to analyze the sites early in order to have time to avoid or resolve potential roadblocks
T3.4	V2G might offers minimum real benefits over unidirectional smart charging, all costs considered (for example battery aging)	5	3	5	5	75	III - Moderate	Do the work described in T3.4 to detect and minimize. Monitor (academic) publications and in-depth analyses from other projects. Fallback strategy: switch project to Smart Charging (unidirectional)
T3.4	Some use cases might not be suitable for V2G	2	8	5	2	56	IV - Slight	a) Try to detect them early in T3.4 and WP1. b) If necessary, focus on the other tasks.
T2.4 T3.1 T3.2	Timings of all/other partners should be aligned with each other	6	5	4	6	150	III - Moderate	Guarding of timings, very close collaboration on timelines
T4.2	Pilots due not support API integration	4	3	7	3	60	IV - Slight	Work with CSV files or other methods to share data

Table 10 Organisational/ operational issues related risks

Relevant project Task	Problem short description	S	O	D	R	Risk Number	Risk severity	Mitigation strategy
T2.2	Requirements not properly captured	6	5	6	4	150	III - Moderate	a) Be aware that not all user requirements might be known by the users. b) Acceptance tests by

								mock-ups, full walk-through of processes
T5.2	The models used to feed the simulation of mass deployment do not have accurate understanding of the mobility needs/ behavior of the population	6	6	9	7	288	II - Severe	1) Do a comprehensive assessment of the mobility needs early in the project. 2) Use demand thresholds to include multiple scenarios representing the different mobility patterns.

Table 11 Behavioural issues related risks

Relevant project Task	Problem short description	S	O	D	R	Risk Number	Risk severity	Mitigation strategy
T2.2	Energy market participation may be hindered by legal frameworks, which are heterogeneous.	6	5	4	7	165	III - Moderate	a) Influence lawmakers in WP6 b) To do whatever could be done with the given legal situation and preparation of SW for improvements

Table 12 Legal issues related risk

8.2 Second Phase Results (M30)

Out of the initially reported 23 risks identified during Phase 1, 12 were encountered and successfully addressed, while 4 did not materialize. The remaining 7 risks persisted and were partially resolved, primarily due to delays in the implementation of technologies and equipment; however, all of these risks were assessed to have a low severity, thus did not affect the project progress significantly.

Type of Risk	Phase 1 (M12)	Phase 2 (M30)
Technical	15	7
Operational	5	
Behavioural	2	
Legal	1	

Risks not occurred		4
Met and dealt with		12
Total	**23**	**23**

Table 13 Number of initial risks versus risks that actually occurred.

The following table presents the 12 risks that were met and successfully addressed during the project:

Type of risk	Relevant project Task	Problem short description
Technical	T1.5 T2.2 T2.4	Scope not correctly defined in terms of development/ testing/ integration phase
Technical	T2.5	Interoperability issues
Technical	T2.6	The introduction of EV Chargers can cause the undesirable drops to the Network Voltage when the chargers are on charge mode (V1G) or undesirable raises when they are on discharge mode (V2G).
Technical	T2.6	The introduction of EV Chargers can cause the undesirable raises to the Network's Line Currents, especially when they are on charge mode (V1G).
Technical	T2.6	After the introduction of the EV Charger or Chargers to a Network bus, the total Apparent Power of the bus can overcome the Nominal Apparent Power, overloading the bus.
Technical	T2.6	When the consumptions of Network's Loads are peaked, The EV Chargers can negatively affect the overall Network Congestion and Power Losses.
Technical	T5.2	Voltage impacts, where the magnitude of every bus voltage is lower than a low limit during the charging (V1G mode) and greater during discharging (V2G or V2X mode).
Technical	T5.2	Stability impacts, where the angle of every bus voltage is out of the specific Network's limits.
Technical	T5.2	Network saturation, where EV charge station (with V2G or V2X capabilities) enhances the short circuit current so much so that no other EV charge station (with V2G or V2X capabilities) or DER can be installed in the close area.
Organisational/ operational	T3.4	V2G might offers minimum real benefits over unidirectional smart charging, all costs considered (for example battery aging
Organisational/ operational	T4.2	Pilots due not support API integration
Legal	T2.2	Energy market participation may be hindered by legal frameworks, which are heterogenous

Table 14 Risks that were met and resolved.

The 7 risks identified during the second phase of the deliverable are presented in Table 15. This analysis primarily focuses on technological developments and activities at the pilot sites. The evaluation of potential risks has yielded the quantified risks listed below, along with the corresponding mitigation strategies implemented to address them. The widespread deployment of the OCPP protocol, full compatibility of chargers with ISO15118, and the introduction of a new generation of EVs capable of V2G technology are expected to mitigate these risks further. The table below presents the results of the Phase 2 risk analysis, detailing the number of risks and their current statuses.

Relevant project Task/WP	Problem short description	S	O	D	R	Risk Number	Risk severity	Mitigation strategy
T2.2	Energy market participation may be hindered by legal frameworks, which are heterogeneous.	5	6	6	3	135	III - Moderate	Knowledge has been transferred to authorities and grid operators. Additionally, several reports published by PwC are being utilized by Charge Point Operators (CPOs) and Distribution System Operators (DSOs) to identify and mitigate potential obstacles.
WP3	Emergence on the market of fully ISO15118-20 compatible EV's in different segment.	6	3	8	2	90	III - Moderate	In 2025, a total of 20 compatible vehicles will be launched. Furthermore, the transfer of knowledge from SCALE, the V2X Alliance, and SCALE partners to the industry has effectively minimized associated risks.
WP3	Full compatibility of chargers to ISO15118.	8	5	8	2	120	III - Moderate	The impact primarily affects the scalability of Vehicle-to-Grid (V2G) solutions, with a lesser influence on Vehicle-to-Business (V2B), Vehicle-to-Home (V2H), and Vehicle-to-Load (V2L) systems. However, V2G is expected to become operational within

Relevant project Task/WP	Problem short description	S	O	D	R	Risk Number	Risk severity	Mitigation strategy
								demonstration ecosystems in the near future.
WP3	Full compatibility of chargers to OCPP2.1	5	4	8	2	100	III - Moderate	The SCALE project includes numerous demonstrators and laboratory testing initiatives at ElaadNL, ABB, and various original equipment manufacturers (OEMs), all of which are actively working to mitigate risks.
WP3	Full compatibility of CPO to OCPP2.1/OCPI3.0 (for V2X charging)	5	4	8	2	100	III - Moderate	The SCALE project includes demonstrators and laboratory testing equipment at CPOs and charging system manufacturers, all of which are actively mitigating this risk.
T4.2	Not all KPI's can be properly measured from all pilot sites	2	3	7	1	24	IV - Slight	At least two or three sites are measuring each KPI. Regardless, the overall risk remains relatively low and is anticipated to have a minimal impact on the project's results.
T5.2	The models used to feed the simulation of mass deployment do not have accurate understanding of the mobility needs and grid capacities	3	4	9	3	72	III - Moderate	Estimations have been conducted to ensure that the project models function properly, taking into account grid requirements and mobility needs, while maintaining the integrity of the processing results.

Table 15 Risks that occurred - Post-analysis

9 Conclusions

Based on a concrete methodology for risks analysis that has been defined within the project, potential risks have been identified by Month 12, since the sooner vulnerabilities are identified, the simpler it is to include them into the design and development phase and manage them. They have a direct or indirect effect on the SCALE solutions smooth operation and functionality.

The second phase of the risk analysis utilized the same methodology to assess the post-analysis risks identified during the technological developments and pilot runs. The risks in this second phase were significantly lower compared to the first phase, indicating that the consortium successfully addressed the majority of them, as well as those with a high severity level during the project's second and third year.

10 References

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