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Comprehensive overview of STEEL-ALIVE

**STEEL Applications for Low Investment
manufacturing of high Value Elements**

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List of Abbreviations

Acronym	Description
ADAS	Advanced Driver Assistance System
AE	Acoustic Emissions
AHSS	Advanced High-Strength Steel
AI	Artificial Intelligence
AL	Arc Length
ANN	Artificial Neuronal Network
BEV	Battery Electric Vehicle
BP	Battery Pack
CAPEX	Capital Expenditure
CNN	Convolutional Neural Network
DL	Deep Learning
DNP	Distance from Nozzle to Plate
DoA	Description of Action
EC	European Commission
ECM	Equivalent Circuit Model
EU	European Union
EV	Electric Vehicle
F2F	Face-to-Face
FEA	Finite Element Analysis
GA	General Assembly
GDPR	General Data Protection Regulation
GFR	Gas Flow Rate
HAZ	Heat-Affected Zone
KPI	Key Performance Indicator
LCV	Light Commercial Vehicle
MAG	Metal Active Gas
MIG	Metal Inert Gas
ML	Machine Learning
NDE	Non-Destructive Evaluation
NDT	Non-Destructive Testing
NVH	Noise, Vibration, and Harshness
OEM	Original Equipment Manufacturer
PHEV	Plug-in Hybrid Electric Vehicle
PM	Project Manager
QA	Quality Assurance
QMS	Quality Management System
RFCS	Research Fund for Coal and Steel
SME	Small and Medium-sized Enterprise
SVM	Support Vector Machine
TL	Task Leader
WFR	Wire Feed Rate
WP	Work Package
WPL	Work Package Leader
WS	Welding Speed



Table of Contents

1	EXECUTIVE SUMMARY	7
2	INTRODUCTION.....	8
2.1	Project summary.....	8
2.2	STEEL-ALIVE objectives	9
3	PROBLEM DESCRIPTION	10
4	STATE-OF-THE-ART	11
4.1	Ligh Commercial Vehicles (LCVs).....	11
4.2	Simulation-based assessment	13
4.2.1	<i>Process simulation</i>	<i>13</i>
4.2.2	<i>Chassis structural simulation</i>	<i>13</i>
4.2.3	<i>Battery pack structural simulation.....</i>	<i>14</i>
4.2.4	<i>Battery pack thermal simulation</i>	<i>15</i>
4.3	AI-Driven Quality Monitoring	16
5	PROPOSED APPROACH.....	18
5.1	Advanced High-Strength Steels (AHSS).....	18
5.2	Three-step manufacturing method: laser cutting, bending and welding.....	19
5.3	Advanced welding processes	20
5.4	Quality monitoring.....	21
6	DEMONSTRATORS	23
6.1	Rear carrier box.....	23
6.2	Battery case.....	24
6.3	Body frame	24
7	RISK IDENTIFICATION AND CONTINGENCY PLAN.....	25
7.1	Amendment procedure.....	26
7.2	Initial risk assessment.....	26
8	ETHICAL GUIDELINES	27
9	STEEL-ALIVE MANAGEMENT PLAN	28
9.1	Project organisation	28
9.1.1	<i>Documentation.....</i>	<i>29</i>
9.1.2	<i>Management structure</i>	<i>30</i>
9.2	Project meetings	30
9.3	Project repository.....	31
10	REFERENCES	33



List of figures

Figure 1. Example of a crush simulation on a battery pack: (left) crush along X-axis, (right) crush along Y-axis 15

Figure 2. CAD representation of the rear carrier box.....23

Figure 3. Schematic representation of the battery case24

Figure 4. Design architecture of the tubular body frame25

Figure 5. Preview of the MS Teams Area32

List of tables

Table 1. Examples of research publications employing multi-sensor data for model training, considering the following variables: welding speed (WS), current, voltage, arc length (AL), gas flow rate (GFR), wire feed rate (WFR), distance from nozzle to plate (DNP) [45]..... 17

Table 2. Risks identified during the proposal phase, along with their respective mitigation strategies26

Table 3. Project's consortium composition29

Table 4. Overview of the project meetings.....31

Table 5. List of channels into which the MS Teams Area is structured.....32



1 Executive summary

The STEEL-ALIVE project, co-funded by the Research Fund for Coal and Steel (RFCS), is a initiative aimed at redefining the manufacturing efficiency, adaptability, and scalability of Light Commercial Vehicles (LCVs). The project advocates for a fundamental shift in automotive production paradigms, transitioning from conventional, capital-intensive stamping and gigacasting methodologies toward a more agile and cost-effective framework. This innovative approach is centred on the exploitation of Advanced High-Strength Steels (AHSS), strategically deployed in both tubular and sheet configurations to address the specific structural demands of the N1 segment. By streamlining fabrication processes, the initiative seeks to bolster the competitiveness of the European automotive industry while simultaneously advancing environmental sustainability through significant mass reduction. This ambitious agenda is executed through the expertise of 7 partners representing 5 European nations.

To bridge these objectives with industrial application, this document provides an overview of the project's conceptual architecture and operational management structure. The narrative commences with a critical exposition of the core objectives and the socio-economic and regulatory drivers that necessitate this intervention. Following this context, a rigorous review of the state of the art is presented, evaluating the contemporary techniques that underpin the project's technical ambitions. These theoretical foundations then lead into a detailed methodology and an assessment of the anticipated results, establishing a roadmap that extends from material characterisation to the physical realisation of the demonstrators.

To ensure the implementation of the methodology, the document further delineates a robust risk management framework and the mitigation strategies required to safeguard the project's trajectory. Complementing this technical oversight, the document addresses the ethical framework governing the research and the overarching management strategy employed to maintain consortium cohesion. Aligned with the terms and conditions established in the Grant Agreement, this deliverable serves as a reference guide for monitoring and validating the project's progress throughout its lifecycle.



2 Introduction

2.1 Project summary

STEEL-ALIVE is an innovative research and development initiative conceived to enhance the manufacturing efficiency, adaptability and scalability of steel-based Light Commercial Vehicles. The project directly addresses the rapidly increasing demand for LCVs, a trend driven by the global expansion of e-commerce and the corresponding need for sustainable and efficient urban logistics solutions. Departing from capital-intensive manufacturing paradigms such as conventional stamping and emerging giga-casting methodologies, STEEL-ALIVE proposes a cost-effective and flexible production framework centred on the exploitation of Advanced High-Strength Steels as the primary feedstock, deployed in both tubular and sheet configurations.

These preforms are processed through agile and modular manufacturing pathways that integrate advanced techniques such as laser cutting, precision bending and advanced welding techniques. This approach aims to exploit the superior strength-to-weight ratios inherent in AHSS, thereby enabling vehicle lightweighting without compromising structural integrity or occupant safety. The technological feasibility of this paradigm will be demonstrated through three representative components: (i) a vehicle battery casing, (ii) a rear carrier box structure and (iii) a body-in-white frame.

To achieve these objectives, the project's technical strategy is organised around two interrelated pillars. The first focuses on the investigation and industrial implementation of advanced welding processes specifically optimised for joining AHSS, while the second concerns the development of novel quality assurance (QA) methodologies incorporating Artificial Intelligence (AI) to enable real-time process monitoring and adaptive control. Collectively, these pillars aim to establish a scalable, digitally integrated manufacturing ecosystem that bridges the gap between material innovation and industrial deployment.

STEEL-ALIVE is guided by a set of ambitious and quantifiable key performance indicators (KPIs), designed to substantiate its transformative potential within the LCV manufacturing sector. These include:

- An **80% reduction** in the required initial capital expenditure (CAPEX) compared to traditional manufacturing lines.
- A **70% decrease** in manufacturing energy consumption and the associated carbon footprint.
- A **30% reduction** in overall production costs.
- A **50% reduction** in the time-to-market for new LCV models.

To realise these outcomes, STEEL-ALIVE has convened a highly qualified, European consortium comprising seven partners representing the entire value chain, thereby ensuring a



multidisciplinary approach spanning from material science to system-level validation. The consortium expertise is structured as follows:

- LCV sector and integration: **IFEVS, StS**
- Advanced manufacturing: **PRIMA, BWI**
- Vehicle modelling and validation: **CIDAUT, CRF**
- Advanced steel production: **AMMR**

2.2 STEEL-ALIVE objectives

In general terms, the overarching objective of STEEL-ALIVE is to accelerate the development of flexible, advanced and sustainable steel manufacturing and quality assurance processes. This strategy is fully aligned with the European Union's environmental mandates, whilst simultaneously reinforcing the economic viability and competitiveness of steel in LCV applications.

To realise this ambitious goal, the consortium has defined a series of specific objectives. These are structured to address everything from material performance to manufacturing processes, quality control and economic impact, as detailed below:

- **To validate the capability of Advanced High-Strength Steels (AHSS)** to meet the application requirements, achieving ultra-lightweight structures and a radical reduction in environmental impact, targeting a 70% decrease in both energy consumption and CO₂ footprint.
- **To demonstrate 6 key technologies** engineered for low-capital-expenditure (CAPEX), flexible manufacturing lines, departing from traditional manufacturing paradigms.
- **To perform robust simulation and physical validation** of the novel AHSS designs, confirming improved stiffness and fatigue strength. For the battery box demonstrator, this includes targeting a 50% performance improvement over current aluminium-based designs.
- **To expand the knowledge base** on laser-based technologies and the deformation mechanics of AHSS materials.
- **To develop novel real-time quality monitoring methodologies** for arc welding, integrating Non-Destructive Testing (NDT) systems.
- **To establish a holistic quality prediction framework** utilising Artificial Intelligence models, targeting >90% accuracy for common welding defects. This will be achieved by correlating real-time sensor data from cutting, bending and welding machines.
- **To elevate defect detection sensitivity and reliability** for both laser and arc welding through a synergistic combination of measurement methods, tailored to specific welding conditions and material properties.



- **To engineer solutions that fundamentally improve process control**, reliability and repeatability, thereby enabling a target 80% reduction in part rejection rates.
- **To execute a comprehensive EU-wide dissemination and exploitation strategy**, communicating the project's findings and demonstrating the competitive advantages of steel in terms of investment, cost, performance and environmental sustainability.
- **To formulate detailed exploitation plans and robust business models** for the three specific use-case applications.

Collectively, these objectives represent a balanced portfolio of fundamental research, technological innovation and industrial application, which seek to transform the landscape of automotive and metalworking sectors.

3 Problem description

The current global climate crisis represents one of the greatest challenges to industrial competitiveness, particularly within the European Union. The stringent environmental regulations introduced under frameworks such as the European Green Deal [1] have established ambitious decarbonisation targets across all industrial sectors. While these measures are designed to stimulate long-term sustainability and innovation, they also impose substantial short-term financial burdens on European enterprises. Compliance with carbon emission standards, implementation of circular economy principles and adoption of low-carbon technologies have significantly increased operational and production costs [2]. Although such expenditures will ultimately translate into strategic investments that mitigate environmental and economic risks, in the immediate term they elevate product prices and consequently reduce the global competitiveness of European manufacturers—particularly in comparison with producers in Asian markets, where environmental regulation is often less restrictive. Moreover, the volatility of raw material prices and the considerable capital investment required for new product development further exacerbate this economic imbalance.

The European automotive industry exemplifies this tension between environmental responsibility and market competitiveness. Following the transition towards electric mobility (accelerated by policies such as the EU Regulation on CO₂ Emission Standards for Cars and Vans [3]) automotive manufacturers have been compelled to invest heavily in adapting production lines to accommodate electric vehicle (EV) architectures [4]. Despite this technological progress, European manufacturers have experienced growing competition from Asian counterparts, particularly in the compact and LCV segments, due to significant disparities in production costs and economies of scale [5]. This imbalance not only affects the automotive industry itself but also exerts a downstream impact on the European steel sector, given that automotive applications represent one of the largest markets for advanced steel products [6].



In response to these challenges, STEEL-ALIVE emerges as an initiative aiming to reinforce the European automotive sector's competitiveness and advance environmental sustainability. Specifically targeting the LCV segment, the project proposes a paradigm shift based on low-investment, high-flexibility manufacturing processes and the use of AHSS as an enabler of vehicle lightweighting. Through this approach, STEEL-ALIVE seeks to minimise production costs and energy consumption, thereby supporting the broader transition towards electric mobility. Moreover, by focusing on steel as a primary material, the initiative contributes directly to the objectives outlined in the Research Fund for Coal and Steel (RFCS) 2025 Work Programme, under the area of “steel applications and solutions for existing and new markets”. Ultimately, STEEL-ALIVE aims to demonstrate that technological innovation in steel manufacturing can serve as a catalyst for sustainable industrial growth, reconciling environmental imperatives with economic viability in the European automotive landscape.

4 State-of-the-Art

4.1 Light Commercial Vehicles (LCVs)

Within the EU regulatory framework, LCVs are formally classified under category N1. This classification pertains to motor vehicles with at least four wheels designed for the carriage of goods and possessing a technically permissible maximum mass not exceeding 3.5 tonnes [7], [2]. Beyond their legal definition, these vehicles constitute a vital pillar of Europe's logistics and service infrastructure, facilitating a wide range of essential activities from last-mile distribution to critical medical response and law enforcement. The socio-economic significance of the LCV segment is further amplified by the structure of European commerce, which is characterised by a high proportion of small and medium-size enterprises (SMEs) that rely on these vehicles as their primary business assets. This importance is currently being reinforced by the sustained expansion of e-commerce, which demands increasingly rapid delivery solutions.

From a regulatory perspective, the primary driver for the decarbonisation of this segment is Regulation (EU) 2019/631 [3], which establishes binding average CO₂ emission targets at the fleet level. For LCV manufacturers, achieving compliance presents unique challenges due to intrinsic operational constraints, particularly regarding payload requirements and the integration of auxiliary equipment, both of which complicate the electrification process [7]. A further distinguishing feature of this sector is the prevalence of the multi-stage type approval process. Many vehicles are initially manufactured as “incomplete” units and subsequently modified by specialist bodybuilders into specific configurations, such as refrigerated vans or ambulances. This degree of customisation often results in a slower transition towards zero-emission technologies compared to the passenger car market.

From a fleet perspective, the European Union manages an extensive LCV parc exceeding 30 million units; however, the average fleet age has reached approximately 12.5 years and continues to rise, highlighting the critical need of fleet renewal policies to meet climate



objectives. While vans dominate the commercial vehicle market, accounting for nearly 80% of all new registrations [8], [9], the market has faced a recent volatility. Despite a partial recovery between 2023 and 2024, EU registrations experienced a 13.2% decline during the first half of 2025. While major markets such as Germany, France and Italy saw contractions, Spain recorded growth during the same period. Diesel remains the dominant fuel, representing roughly 82% of new registrations due to its operational efficiency and favourable total cost of ownership. In contrast, Battery Electric Vehicles (BEVs) and Plug-in Hybrids Vehicles (PHEVs) achieved a combined share of 9.5% in early 2025, while traditional hybrids remained marginal at 2.6% [7], [9], [10].

Looking ahead, LCV volumes are expected to follow cyclical trajectory underpinned by 3 structural drivers:

- The growth of e-commerce and last-mile delivery
- Increasingly strict urban delivery regulations
- The urgent need for fleet renewal

Concurrently, a notable trend is the steady increase in average vehicle mass, attributed to a shift towards larger vehicle segments, the integration of ADAS, and the significant weight associated with battery packs and structural reinforcements for electrification. Quantitatively, the average mass of vans rose from ~1,748 kg in 2015 to ~1,870 kg in 2019, an increase of 7% [11]. A critical regulatory implication of this trend is that battery weight may cause certain electrified variants to exceed the 3.5 tonne threshold (from N1 to N2). Such a shift activates heavy-vehicle requirements, including speed limiters and tachographs, which may deter the adoption of electric LCVs. Consequently, OEMs and bodybuilders must prioritise the optimisation of lightweight structures to preserve payload capability while remaining within regulatory limits.

The shift towards electrification therefore necessitates the development of fatigue-resistant lightweight structures that can endure demanding duty cycles and high payload variability without compromising durability. Although European van production remains largely steel-based for reasons of cost efficiency and repairability, the pressure to comply with CO₂ targets is driving the adoption of High Strength Steel (HSS) and Advanced High Strength Steel (AHSS). These materials are increasingly deployed in critical load parts (rails, reinforcements, crash structures), allowing for gauge reduction while maintaining stiffness and crashworthiness [9], [12], [13]. In parallel, manufacturing solutions such as tailored blanks, roll-formed AHSS sections, hydroformed parts, and advanced joining techniques (such as spot welding + structural adhesives) have become standard practice to balance stiffness, fatigue performance, and mass targets.

Finally, to remain competitive in a cost-sensitive market, OEMs are pursuing the re-engineering of core components through modular vehicle architectures. The adoption of modularity across the frame, battery casing, and cargo area enhances platform flexibility and reduces engineering duplication. When combined with low-investment manufacturing process, such as laser



cutting, bending and welding, these modular approaches avoid the substantial capital expenditure associated with traditional stamping dies. This strategy is particularly well suited to the medium-volume production profiles that characterise many LCV applications. Ultimately, securing a market share in the European LCV sector requires a precise balance between regulatory compliance, cost efficiency, and operational performance, depending largely on the industry's ability to integrate advanced material and modular design.

4.2 Simulation-based assessment

Without losing sight of the automotive engineering, numerical simulation has evolved from a secondary validation tool into a primary driver of structural and manufacturing innovation. Within the specific domain of LCVs, the application of advanced simulation techniques is indispensable for addressing the dual imperatives of mass reduction and regulatory compliance. This section reviews the current state of the art in simulation methodologies, focusing on their capacity to model the AHSS components, from the initial forming stages to the final structural integrity.

4.2.1 Process simulation

Current scientific literature identifies the simulation of manufacturing processes (specifically forming) as a critical frontier in predictive engineering. In conjunction with physical experiments and trials, simulations of processes are required to accurately replicate their dynamics on the material, drawing upon the existing scientific knowledge in the field.

Within the field of material forming, there are several topics that are worth being explored by means of simulations. For instance, for automotive applications, springback during forming of AHSS is one of the key issues to solve. Several authors have explored this phenomenon in different AHSS grades. Wagner et al [14]. developed material models for DP600 taking into account the Young's modulus reduction that occurs during successive loading-unloading cycles in tensile mode, correlating the model with bending-under-tension tests. A similar approach was followed by Cobo et al. [15], applied to different DP AHSS from DP780 to DP1400. Other topic of interest is the numerical modelling of edge cracking in AHSS. As example, Kim et al. [16] simulated the hole-edge cracking process for AHSS in the static bend test using LS-Dyna, exploring different failure criteria as a means of representing the local formability limits of the AHSS for automotive structural components. Regarding the modelling of fracture and damage mechanisms affecting AHSS, Pereira et al. [17] provided a comprehensive overview of the stress states covered in model parameter calibration processes, validation experiments employed, and finite element models that can be found in literature.

4.2.2 Chassis structural simulation

The structural integrity of the chassis acts as a key indicator of load-carrying capacity, significantly affecting safety, handling stability, and NVH performances. This is why simulating physical tests becomes a value tool during the design phase, allowing for virtual optimisation of the body frame prior to creating any physical prototypes. A crucial aspect of this evaluation



involves analysing static stiffness. Given that the body frame endures a huge part of the bending and torsional loads during operation, its static stiffness serves as an important measure of the robustness of the LCV [18]. Zhang et al. [19] analysed the stress, strain and modal analyses of the frame structure of a light van-type electric truck using Abaqus, defining a simulation-based methodology to ensure that optimal structural performance and lightweight are achieved at the same time. Other relevant scenarios to be simulated to understand the behaviour of body frame structures are related to its durability. As the vehicle's body frame is subjected to vibrations caused by rough roads or by the loads transported, the structure can experience failure due to fatigue caused by vibrational modes or premature weld failure, as stated by Numanoy et al [20].

4.2.3 Battery pack structural simulation

In the field of electric vehicles, the structural assessment of the battery pack is paramount, as the enclosure must satisfy rigorous functional and safety requirements simultaneously. State-of-the-art research utilises Finite Element models to calculate intricate stress and strain distributions under diverse load cases, including static torsion, mechanical shock, and high-velocity impact scenarios. These simulations are critical for determining the optimal material grade and thickness, enabling a lightweight design that does not compromise crashworthiness. This section highlights notable research, through several examples.

Pan et al. [21] proposed a strategy to optimize AHSS battery enclosure design based on several simulation steps. First, a random vibration analysis is carried out to make an initial guess of the materials and thicknesses of each of the BP components. Then, a fixed-frequency vibration analysis, a mechanical shock analysis, and a fatigue life analysis are carried out to optimize the materials and thickness selection. Finally, the crashworthiness performance of the BP is checked by means of crash and crush (Figure 1) simulations. This last step is particularly important, as it can highlight potential safety issues such as explosions and fires. In their work, a Johnson-Cook constitutive model was employed to describe the behaviour of dual-phase steels. They also highlight that, to carry out a robust design work, it is important to investigate the crashworthiness in near worst-case scenarios [22]. By implementing AHSS grades and optimised design, the BP enclosure weight was reduced by 6.6%, while at the same time increasing mechanical performance.

Another common type of simulation that is performed on battery packs to assess its crashworthiness behaviour is mechanical abuse simulations. Turner et al. [23] employed LS-Dyna to simulate an indentation test performed on a Nissan Leaf battery module. The explicit time integration method used allowed an efficient modelling of non-linearities in material, structure and geometry during the simulation.



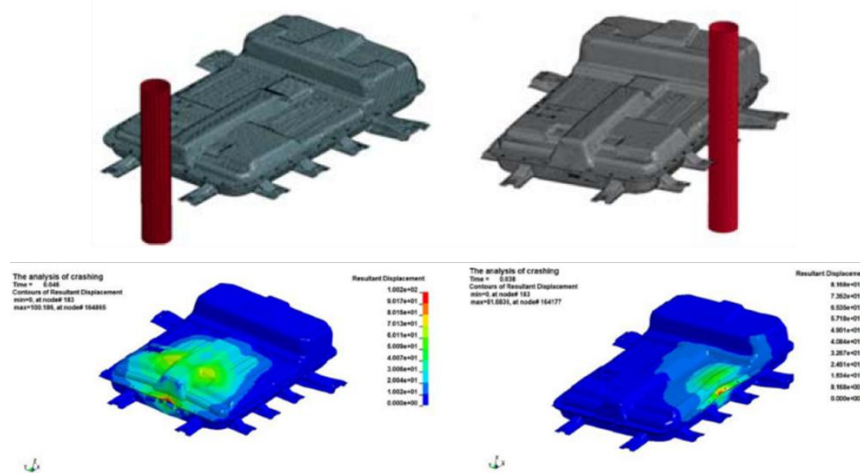


Figure 1. Example of a crush simulation on a battery pack: (left) crush along X-axis, (right) crush along Y-axis

In a full vehicle scenario, it is well-known that the most critical crash scenario is the crash against a pole. Muresanu et al. [24] analysed the mechanical behaviour of a battery frame impacting a pole when integrated in a vehicle structure (2012 Toyota Camry) by simulating load cases similar to FMVSS 214 and UNECE R135 regulations. In a subsequent stage, the simulations were modified to explore the limits of crashworthiness, by modifying the pole impact position and by increasing the test speed. In their study, several frame designs were analysed, focusing on determining the maximum intrusion of the pole. A similar study (from a methodological perspective) was conducted by Kawsar et al. [25]

The last family of simulations that are commonly implemented to analyse the structural integrity of battery packs are those representing underbody impacts on the battery case. Kim et al. [26] simulated a 7m drop height for underbody impact testing, using an explicit-dynamics non-linear approach implemented in ANSYS. Their analysis identified primary stress concentrations at the corners of the lower frame. They also found that the presence or absence of the upper cover had minimal impact on the overall stress distribution, although it served a supplementary role in mitigating local stress concentrations.

4.2.4 Battery pack thermal simulation

Parallel to mechanical integrity, battery thermal simulation has become a vital research domain, driven by the thermal sensitivity of lithium-ion batteries. The scientific literature categorises thermal models into two primary families [27]: (i) descriptive models, which replicate the internal physical and electrochemical phenomena, and (ii) behavioural models, which function as "black boxes" to reproduce macroscopic thermal responses. These can be further classified as distributed models, where temperature gradients vary continuously, or lumped models, which treat the battery as a series of discrete elements with average temperature values. Depending on the required spatial resolution, these models range from zero-dimensional (0D) to multi-dimensional (3D) architectures. Furthermore, the degree of coupling between electrical and thermal models defines whether they are correlated or uncorrelated. Research by Lamrani et al. suggests that lumped thermal models, when coupled with heat generation algorithms,

offer a robust balance of accuracy and computational efficiency for predicting real-world battery functioning [28].

A comprehensive thermal model typically accounts for four distinct processes: (i) irreversible electrical power generation (Joule heating), (ii) reversible entropic heating, (iii) heat generated by concentration changes during the mixing phase as the electrochemical reaction advances, and (iv) energy dissipation from phase transitions. While all four influence the system, it is common practice in the literature to prioritise the first two primary energy sources [29]. Moreover, many researchers employ Equivalent Circuit Models (ECM) to represent battery dynamics, using electrical components such as resistors and capacitors to simulate thermal behaviour within a circuit network [30].

Within the context of LCV design, thermal simulation is increasingly viewed as a complement to mechanical performance evaluations. There is a growing trend toward employing simplified models to characterise the thermal environment of the battery pack, particularly concerning the onset of thermal runaway. Current recommendations for thermal runaway analysis emphasise the importance of considering both edge-trigger and central-trigger cell scenarios, as the temperature profiles and propagation paths for neighbouring cells differ significantly depending on the location of the initial failure [31]. This holistic approach ensures that the battery case is not only crash-resistant but also thermally resilient under both operational and abusive conditions.

4.3 AI-Driven Quality Monitoring

In tandem with the prior advancements, the implementation of quality monitoring frameworks incorporating non-destructive evaluation (NDE) techniques is gaining considerable momentum, largely driven by the principles of Industry 4.0. Traditional inspection methods often face major obstacles, such as high time requirements, the drawbacks of destructive testing, and the difficulty of inspecting an entire component. Conversely, advancements in NDE, supported by the evolution of sensor technologies, now facilitate the in-situ and real-time detection of disturbances and defects during the welding processes. Such capabilities offer cost-efficient, sustainable solutions that minimise the non-value-added activities historically associated with inspection cycles [32]. These breakthroughs are supported by the integration of specialised sensors and advanced data processing architectures, most notably Artificial Intelligence.

The following technologies represent the current state of the art in the welding sector:

- **Acoustic Emissions (AE):** This technique relies on the detection of elastic waves generated by the deformation of a material's atomic structure. These waves induce mechanical changes in piezoelectric sensors, allowing for the real-time identification of discontinuities or density variations. Research into arc welding confirms AE's efficacy in diagnosing arc instabilities and precisely localising defects [33].



- **Current-voltage sensors:** Characterised by an exceptionally high response frequency, these sensors are pivotal for evaluating process stability. For instance, Zhan et al. [34] proposed an online monitoring methodology based on arc voltage signal analysis. Existing literature suggests a robust correlation between electrical parameters and quality indicators—such as porosity—enabling the classification of distinct weld quality grades [35].
- **Visual sensors:** These provide the most comprehensive data regarding weld morphology [36]. By capturing optical radiation, they offer insights into temperature distribution, fusion status, and molten pool dynamics.
- **Spectroscopic analysis:** This method quantifies the wavelengths of light emitted by the welding arc; fluctuations in spectral intensity serve as reliable predictors of arc stability.
- **Geometrical and arc sensors:** Laser triangulation sensors are utilised for pre-weld seam tracking and post-weld geometrical verification, while simple arc sensors monitor electrical variations to automate seam alignment [37].

These technologies, while representing significant advances, face limitation when relying on a single sensor for data collection. This is largely due to the unreliability of the measured data, which can be partly attributed to challenging environmental conditions. Such an approach can undermine the stability of the monitoring process. To address this, researchers have turned to multi-sensor fusion, which combines data from several sources for a more complete overview [38], [39], [40], [41], [42], [43], [44]. However, this method introduces large amounts of redundant data, significantly increasing computational demands and posing challenges to the edge computing. This is where artificial intelligence becomes essential, offering an effective means to manage these challenges. By processing multi-dimensional datasets, AI facilitates predictive quality solutions. In this context, predictive quality involves the application of Deep Learning (DL) to forecast the integrity of a weld based on real-time data. These models can identify complex relationships between material properties, process parameters, and the resulting weld quality, thereby enabling proactive quality interventions during manufacture [45].

Table 1. Examples of research publications employing multi-sensor data for model training, considering the following variables: welding speed (WS), current, voltage, arc length (AL), gas flow rate (GFR), wire feed rate (WFR), distance from nozzle to plate (DNP) [45]

Paper	WS	Current	WFR	GFR	AL	DNP	Voltage
[46]	✓	✓	✓				✓
[47]	✓	✓			✓		✓
[48]	✓	✓	✓				
[49]	✓		✓			✓	✓
[50]	✓	✓			✓		
[51]			✓				✓
[52]		✓	✓				
[53]	✓	✓	✓	✓	✓		
[54]	✓	✓					✓



In a comprehensive review of advancements in arc welding, Bestard and Absi Alfaro [55] highlighted Artificial Neuronal Networks (ANN) as one of the most prevalent methodologies over the past half-century. The synergy between ANNs and the aforementioned sensing technologies is widely documented. Beyond basic modelling—such as using ANNs for Metal Inert Gas (MIG) or Metal Active Gas (MAG) processes—more complex architectures like Convolutional Neural Networks (CNNs) are increasingly employed [56].

For example, Acoustic Emission data can be converted into spectrograms, which serve as high-dimensional features for CNNs, allowing for the in-situ classification of quality levels. Similarly, CNN-based algorithms are utilised for gap detection, deposition rate control, and the analysis of thermographic imagery for defect detection and seam tracking.

This paradigm extends to hybrid welding processes (e.g., combining arc welding with adhesive bonding). Given the complex interactions in hybrid joints, the integration of AI with multiple NDE methods is essential for ensuring joint integrity [57]. A notable example is the work of [58], which combined multi-sensor data fusion with CNNs to achieve highly accurate, real-time defect detection in complex joining scenarios.

The same applies to the laser welding. Several research studies confirm the effectiveness of AI-based quality monitoring methods in this domain [59]. Noteworthy is the work presented in [60], which employed data collected from multiple sensors, including plasma radiation and spectral signal, to detect and classify welding defects using ANN and support vector machine (SVM) models. The study was conducted on galvanised steel sheets, and the results indicated that the ANN model outperformed the SVM model in terms of accuracy and classification.

5 Proposed approach

Building upon the foundational state-of-the-art concepts discussed previously, STEEL-ALIVE will adopt a multi-disciplinary methodology designed to achieve the project's objectives. The research will be structured into several interdependent work streams, aligned with the specific goals. Below is a description of the approach that will be followed for material characterisation, advanced manufacturing and quality monitoring, that constitute the central focus of the initiative.

5.1 Advanced High-Strength Steels (AHSS)

Focusing on the strategic requirements of the LCV sector, the STEEL-ALIVE strategy introduces a paradigm shift in vehicle manufacturing by starting production from AHSS tubes and flat sheets. These semi-finished materials will be processed using simplified, high-speed techniques such as cutting, folding, punching and welding. This approach avoids the need for massive initial investment in dies, presses, stamping machinery and complex robotised assembling cells. The benefits are:



- It lowers the capital required for OEMs to start large-scale manufacturing.
- The lead time from design to part production is projected to be significantly reduced to approximately 3 months.
- It will accelerate the design and development of a thoroughly simplified, highly flexible and high-speed production line.
- It improves the environment by reducing noise levels and minimising exposure to harmful fumes.

To underpin this novel manufacturing method, a comprehensive scientific understanding of AHSS is essential. The methodology therefore encompasses a rigorous characterisation of the material at both the micro- and macro-scales, with the objective of enabling the development of the technological processes such as laser cutting, bending, punching and welding on tubes applied to innovative and high-performance materials. This investigation will:

- gather valuable data to define the operational limits of the new manufacturing processes.
- use the gathered data to improve the accuracy of numerical simulation models describing both material behaviour and process outcomes.
- model the structural performance of the final AHSS components under crucial operating conditions, including torsion, fatigue, and crashworthiness. Such analyses will be conducted across different material thicknesses and incorporate novel hybrid joining approaches, such as the combination of welding with structural adhesives.

Guided by the functional and performance requirements identified, specific AHSS grades will be selected and subjected to an exhaustive characterisation regime. This process will include:

- Microstructural characterisation,
- Mechanical characterisation, such as standard tensile tests,
- Corrosion resistance testing across various zones (unwelded zone, welded zone...)
- Fatigue resistance testing.

Within this technical framework, tubular steel products will be proposed for the body frame to satisfy the requirements identified through simulation. Both coated and uncoated products will be evaluated and compared. Simultaneously, flat steel products will be developed for the battery case and the rear carrier box, ensuring that each component is precisely engineered to meet its specific functional requirements.

5.2 Three-step manufacturing method: laser cutting, bending and welding

In modern manufacturing, particularly within the automotive sector, the dual goals of reducing upfront investment and demonstrating comprehensive sustainability across the value chain are important. Achieving these goals requires a radical shift toward highly flexible manufacturing and the simplification of material use to meet structural performance targets.



The proposed three-step manufacturing method, laser cutting, bending and welding, represents a profound innovation by ensuring high-speed manufacturing without the massive initial capital expenditure and production lead times associated with conventional stamping or emerging giga casting processes. This new industrial production paradigm takes on even greater relevance when applied to the production of LCVs, where customization is highly variable. A production system that integrates laser cutting systems with bending and welding systems can produce most of the components of an LCV starting from basic components such as sheet metal and tubing.

This strategy completely eliminates the need for:

- **Dies and presses:** There is no requirement for heavy, expensive steel dies, stamping machinery, or giga casting equipment.
- **Material complexity:** Steel is employed as the sole material to achieve the required structural values, simplifying the supply chain and manufacturing process and guarantee complete and simple recycling of all steel components.

By implementing this three-step, software-driven process, manufacturers can accelerate design and production, realise vast cost savings on initial investment, and ultimately demonstrate a sustainable and competitive manufacturing model in Europe. The extreme simplicity of customizing vehicle components is made possible by PRIMA INDUSTRIE's ERP and CAD/CAM software systems, which are capable of automatically and consistently generating working programs for the three processing phases for each component. The extreme flexibility of this type of component production makes it possible to carry out specific customizations even on a single vehicle at very low or even zero cost.

5.3 Advanced welding processes

This initiative seeks to significantly advance the state-of-the-art in welding by developing comprehensive recommendations, guidelines and training/certification programs focused on the optimal joining of AHSS. The technical scope of this methodology explores a spectrum of advanced joining methods, ranging from the optimisation of robotic MIG/MAG welding -the most prevalent industrial technique- to the implementation of manual laser welding, which offers high-precision assembly with a minimal heat input. Furthermore, the strategy incorporates hybrid joining techniques, where different processes are combined to achieve superior structural integrity. While these resources are initially tailored for light commercial vehicles, the aim is to provide a versatile framework for stakeholders across the wider metal industry.

A central objective of this research is the definition and optimisation of key geometrical and electrical parameters, such as current, voltage and wire feed speed, which are essential for controlling advanced welding processes. By establishing these optimised parameters, the STEEL-ALIVE project targets the following improvements:

- By precisely controlling the welding process, the total heat input will be lowered.



- This lower heat input leads directly to a major reduction in the HAZ size, targeting a 20-30% reduction. A smaller HAZ is crucial because it helps to better preserve the steel's original microstructure.
- Better microstructure conservation ultimately leads to improved final mechanical properties and enhanced fatigue resistance of the joined components.
- The process optimisation is projected to achieve a significant 50% reduction in distortion, minimising the need for costly rework.
- The efficiency will be boosted with an expected 20-50% increase in welding speed (depending on the specific process and application).
- The higher quality and reduced distortion resulting from the optimised process will minimise or eliminate the need for subsequent, costly operations such as heat treatment or machining.

It is important to emphasise that the final recommendations, guidelines, and training/certification programmes will have a broad impact, extending far beyond the LCV automotive application to serve the entire metal industry involved in welding extremely thin AHSS structures.

5.4 Quality monitoring

Simultaneously, STEEL-ALIVE seeks to transcend traditional quality assurance paradigms by implementing an intelligent, in-line monitoring system specifically for the most widely adopted joining technique, namely robotic MIG/MAG-welding. Rather than relying on conventional post-process inspection, the proposed approach seeks to establish a proactive and self-optimising production environment in which weld quality is continuously assessed and improved during operation. The proposed methodology is structured into two main stages:

Sensor fusion and knowledge generation

The project aims to integrate a diverse set of data streams through advanced sensor fusion techniques, combining at least three distinct sources of information to enable robust weld quality monitoring. These sources include, but are not limited to, infrared thermography, process parameters (such as current, voltage and wire feed speed), and acoustic emissions data. The integration of these measurements is intended to provide a comprehensive and holistic representation of the welding process. By correlating data from multiple sensing modalities, the system will acquire the necessary knowledge to identify the optimal combination of sensors and measurement techniques required to ensure reliable quality assessment. Prior to full integration, the inherent limitations and constraints associated with each sensing technique will be systematically identified. To this end, findings reported in the relevant scientific literature will be critically compared with results obtained from a series of controlled experimental trials.



Development of novel self-learning algorithms and AI integration

The core intelligence of the system will be realised through advanced AI and Machine Learning (ML) techniques, designed to extract meaningful relationships from complex datasets. These algorithms will establish quantitative links between non-destructive testing data, welding process parameters, and the resulting weld quality. A comprehensive experimental campaign will be conducted to generate labelled datasets, in which welds are classified as acceptable (OK) or non-acceptable (NOK). This classification will be achieved through destructive testing performed after weld completion, and the resulting information will be used to train and validate the learning algorithms. To further enhance model robustness and performance, data augmentation techniques based on ANNs will be employed to expand the effective size and diversity of the training dataset.

In addition, AI-based methods will be utilised to model and analyse the complex, non-linear relationships inherent in the welding process, enabling real-time estimation of weld quality. The developed algorithms will also be used to refine process parameters and optimise welding conditions for different grades and thicknesses of AHSS, with particular emphasis on fillet welds, which have received limited attention in the existing literature.

To support the implementation of this methodology, a structured and systematic work plan will be followed. This will include the development of rigorous data acquisition protocols to ensure the collection of high-quality datasets that do not compromise the learning process of the AI models. Modular and flexible system architectures will be designed to facilitate the integration of the models into available welding equipment. Furthermore, transfer learning strategies will be investigated to improve the robustness of the models with respect to the detection of a wide range of defects. Particular emphasis will be placed on the development of models capable of operating in real time and being deployed at the edge, thereby minimising latency and computational overhead. Finally, operational costs and practical implementation barriers will be assessed once the system is fully operational, and its performance will be benchmarked against existing industrial methods and tools. These comparisons will be conducted under controlled laboratory conditions as well as during prototype production trials.

On balance the proposed methodology is expected to yield tangible and measurable improvements in production efficiency and weld quality, as defined by the following **Key Performance Indicators**:

- Process parameter and system health prediction: The system will be designed to deliver accurate predictions of key process parameters and overall system health with a latency of less than 100 milliseconds.
- Early detection of weld defects: Real-time identification of anomalies will enhance process robustness, ensuring consistent weld quality and preventing the propagation of defects throughout the production line.



- Reduction in rejection rate: A principal objective is to achieve an 80% reduction in the rejection rate of welded components, leading to significant savings in material consumption and time.
- High-accuracy defect prediction: The self-learning AI/ML models will be developed to predict the occurrence of the most critical weld defects with a high level of confidence, targeting an overall prediction accuracy exceeding 90%.

6 Demonstrators

6.1 Rear carrier box

Among the three described demonstrations actions, STEEL-ALIVE will focus on the development of a rear carrier box. This prototype will adhere strictly to the paradigm outlined in Section 2.1. The design will meticulously consider the requirements of both last-mile vehicle manufacturers and the end-users within the consortium, aiming to align with current market trends.

Specifically, the research will investigate alternatives incorporating slightly curved top and side surfaces. This is intended to accommodate diverse delivery conditions, minimise vibrations and enhance the overall aesthetics of the component.

The box will be constructed exclusively from parts produced using laser cutting and sheet metal bending/punching techniques. Only a few elements, such as the hinges, will be assembled using screws; the remaining parts will be joined via advanced welding methods. This approach is designed to significantly reduce the steps required from the design phase to prototype construction, potentially shortening the timeline to only a few days, as it eliminates the need for manufacturing moulds for production.

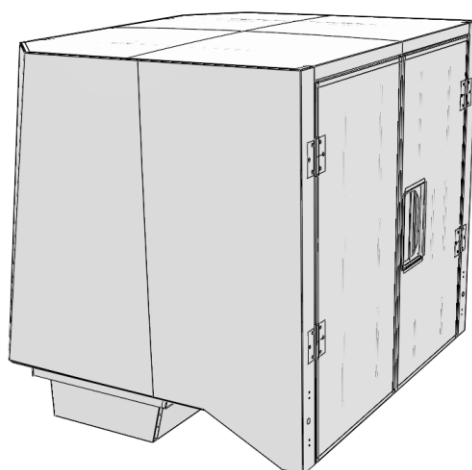


Figure 2. CAD representation of the rear carrier box



6.2 Battery case

Building upon the manufacturing principles established for the rear carrier box, the practical case study concerning the battery system will be based on a real-world system to ensure maximum applicability in operational environments. STEEL-ALIVE will concentrate its efforts on the redesign of this component, employing the innovative paradigm that forms the project's core.

Specifically, the initial design will feature two thin-sheet layers of AHSS sandwiching an intermediate insulation layer (foam). The joints between the covers and the remaining layers will be achieved using adhesives or screws, pending the results obtained during the development process.

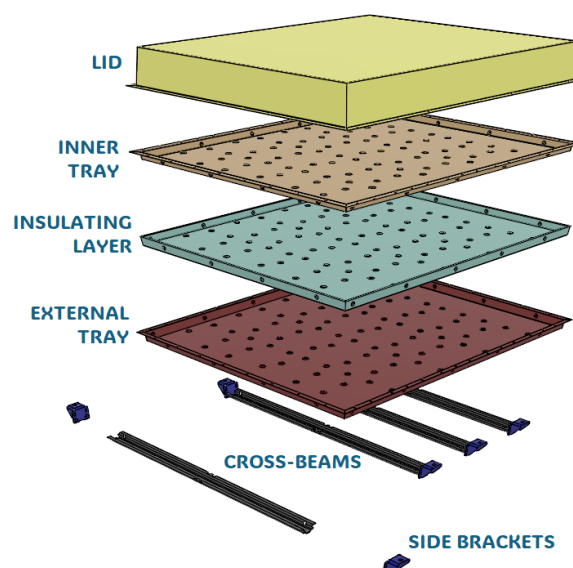


Figure 3. Schematic representation of the battery case

Through this multi-layer structure, the project seeks to optimise the crash performance of these components. Furthermore, thanks to the innovative design, the battery casing will provide a significant level of thermal insulation, which will render its operation practically independent of external temperature variations.

Crucially and mirroring the previous case, the design will permit manufacturing solely via laser cutting, followed by bending and punching operations. Dies or stamped parts will not be required, thus eliminating the need for new tooling to manufacture the same component in different sizes. Consequently, the design can be easily adapted to any type of vehicle or body configuration. Moreover, the system will allow for the universal integration of different types of battery cells, whether prismatic, pouch, or cylindrical.

6.3 Body frame

In addition to the component-level prototypes, STEEL-ALIVE will also dedicate efforts to the redesign of the body frame for a medium-sized light commercial vehicle. To achieve this,

strategically arranged steel tubular components will be employed to form the vehicle's structure. The materials and dimensions of the high-strength tubes will be selected based on their suitability for the specific sub-modules into which they will be integrated. The tubes will be laser-cut, bent and welded to facilitate assembly, adopting a design akin to a 'Lego-type' structure.

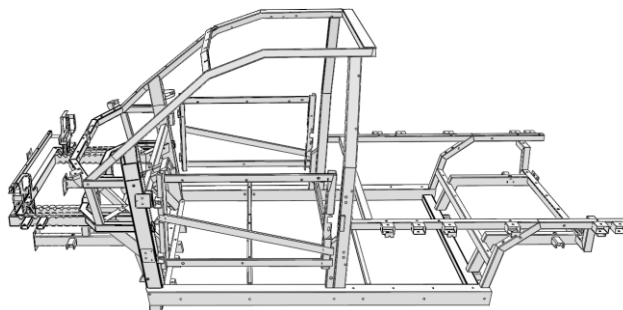


Figure 4. Design architecture of the tubular body frame

While this assembly method does not represent a novelty, given that TESLA uses it (in stainless steel) for the manufacture of the Cybertruck, STEEL-ALIVE takes this approach further by significantly reducing the quantity of dies or stamped parts required in the production process, leveraging the unique paradigm that drives the project.

7 Risk identification and contingency plan

To ensure the control of the project's solutions, a Quality Management System (QMS) has been formally established, adhering strictly to the requirements of ISO 9001:2015. The fundamental objective of this QMS is to facilitate the periodic and systematic review of project planning and execution, thereby guaranteeing its suitability, adequacy and overall effectiveness.

The QMS is operationalized through a specific suite of tools and procedures designed to streamline and govern the requisite quality management processes. While this formal set of tools constitutes the core operational foundation of the QMS, it is critically augmented by the integration of a proactive Risk Management framework. This integration significantly contributes to problem prevention and fosters a culture of continuous improvement.

When the implementation of the QMS tools leads to the identification of a risk, the STEEL-ALIVE consortium adopts a model of shared accountability. Crucially, risk management responsibility is decentralised; it is not solely the purview of the Project Coordinator but is distributed across Work Package Leaders and Task Leaders. Risks are identified at four levels:

- **Task-level risks:** Identified by Task Leaders.
- **Work Package-level risks:** Affecting an entire WP and managed by the relevant WPL.
- **Project-level risks:** Affecting more than one WP and monitored directly by the Project Coordinator.



- **Deliverable-related risks:** Concerning delays or quality issues in deliverables.

All identified risks must be communicated to the next hierarchical level (Task Leader → Work Package Leader → Project Coordinator). To determine their significance, risks are systematically classified based on their probability of occurrence and potential impact or severity. These factors are documented in a centralised risk register accessible to all partners and updated continuously.

Depending on the evaluation, one of the following risk-handling strategies is applied:

- **Risk acceptance:** No proactive measures are taken.
- **Risk reduction:** Measures are adopted to decrease either the probability and/or the impact of the risk (e.g., activity rescheduling or scope modification).
- **Risk transfer:** External parties are involved to manage the risk.
- **Risk avoidance:** Strategies are employed to completely eliminate the threat.

7.1 Amendment procedure

If the activation of a contingency plan requires modifications to the work plan -such as rescheduling or altering tasks- a formal amendment procedure is followed:

1. The Work Package Leader submits a modification request to the Project Coordinator.
2. If agreed, the Coordinator prepares a draft of the revised work plan.
3. The changes are communicated to the Project Officer and an amendment session is opened in the EC portal.
4. Upon approval, the updated version of the work plan becomes effective.

7.2 Initial risk assessment

As a starting point for this framework and prior to the implementation of the QMS, the consortium had already identified and evaluated several potential risks during the proposal stage. Table 2 summarises this preliminary assessment together with the corresponding mitigation strategies.

Table 2. Risks identified during the proposal phase, along with their respective mitigation strategies

#	Type	Description	WP(s)	P	I	Mitigation Strategy
1	MR1	Underestimation of project duration/resources	All	L	M	Continuous monitoring by WPLs and agile cost management
2	MR2	Communication issues among partners	All	L	L	Coordinator to establish communication flows and mediate if necessary
3	MR3	Potential withdrawal of key project leaders	All	L	L	Emergency procedure to replace key leaders



4	MR4	Delays in achieving deliverables and milestones	All	L	L	PM or WPLs to propose rescheduling of non-critical activities
5	MR5	Insufficient stakeholder engagement in communication activities	WP5	L	M	Intensification of exchanges with multipliers and design of new measures if needed
6	TR1	Theoretically assessed designs fail to meet requirements	WP2	L	L	Use of FEA simulations with validated material properties
7	TR2	Manufacturing line concept cannot cover all use cases	WP2	L	M	Early definition of process and product requirements with manufacturers and end-users
8	TR3	AI/ML models lack sufficient accuracy in defect detection	WP3	M	M	Intensive training with controlled data and creation of additional datasets if required
9	TR4	Digital Twin insufficiently representative of welding process	WP3	L	M	Close interaction among relevant tasks and continuous refinement of the model
10	TR5	Inability to create and validate prototypes at all sites	WP4	L	H	Close coordination between partners to solve logistical issues, supported by local partners
11	TR6	Real-time quality monitoring affected by industrial environment	WP5	M	M	Development of filtering/noise-reduction methods or use of more robust sensors
12	TR7	Concerns regarding objective fulfilment by different actors	WP5	M	M	Continuous monitoring of the quality and risk plan; dedicated meetings organised

Legend: **P = Probability, I = Impact, L = Low, M = Medium, H = High.**

According to this assessment, the risks requiring the closest monitoring are TR3 (AI/ML model accuracy), TR6 (real-time quality monitoring in industrial environments) and TR7 (fulfilment).

8 Ethical guidelines

STEEL-ALIVE is committed to operating under the highest ethical standards and in alignment with EU values, as is required by European programmes. Its ethical framework is fundamentally based on ensuring research integrity and actively preventing the misuse of its outcomes. To fulfil this mission, the project partners have consented to adhere to the core principles established in the European Code of Conduct for Research Integrity [61], which includes reliability, honesty, respect, accountability, openness, reproducibility and traceability.

Focusing on the specific ethical domains addressed by this Code, STEEL-ALIVE plans to address them as follow:

- **Human participation and research:** As the project does not foresee any research activities involving human participants, no measures in this area will be applied. The



commitment is to avoid any study or physical intervention on individuals, as well as the collection of samples of human origin.

- **Personal data protection:** CIDAUT, as the coordinator, will oversee all matters related to data protection. Its Data Protection Officer will assume the responsibility for processes such as the anonymisation of data, should it become necessary, thereby ensuring that the final project results are devoid of personally identifiable information. In this manner, any use of personal data will be guaranteed to be under strict confidentiality regulations and in compliance with the General Data Protection Regulation (GDPR, Regulation 2016/679). Furthermore, technical and regulatory measures will be implemented to safeguard the information, particularly against risks derived from advanced technologies such as AI.
- **Health and safety:** STEEL-ALIVE will be governed by the “do no harm” principle. To this end, it will comply with current international, EU and national legislation regarding public health and occupational safety, including Directive 2006/25/EC.
- **Activities in non-EU countries:** Since the project consortium does not include partners from non-EU countries, nor does it involve the import or export of materials or data, there are no current obligations on this point. However, should the circumstances change, the project is committed to ensuring that no activity negatively affects participants or exploits local resources.
- **Artificial Intelligence (AI):** The project will develop an AI-based system to monitor process quality and predict defects in welded joints. This system is considered an “AI System” under the EU AI Act, which urges STEEL-ALIVE to follow the recommendations included in the guide, “Ethics by Design and Ethics of Use Approaches for Artificial Intelligence” [62]. Specifically, actions will be grounded in the following six essential ethical principles: (i) Respect for Human Agency, (ii) Privacy and Data Governance, (iii) Fairness, (iv) Individual, Social and Environmental Well-being, (v) Transparency and (vi) Accountability and Oversight.

9 STEEL-ALIVE Management Plan

9.1 Project organisation

The project gathers a working group comprising seven partners from different European countries. These partners were selected based on their profiles and expertise required to address and achieve the project’s objectives (see Table 3 for more details).



Table 3. Project's consortium composition

Participant No.	Participant organisation name	Short name	Country
1 (Coordinator)	CIDAUT	CID	Spain
2	BWI/BWI-IND	BWI	Belgium
3	PRIMA INDUSTRIE	PRIMA	Italy
4	IFEVS	IFEVS	Italy
5	CRF-Stellantis	CRF	Italy
6	STREETSCOOTER	STS	Germany
7	ARCELOR MITTAL	AMMR	France

Given the diverse nature of the group, it is essential to ensure that all beneficiaries share a clear understanding of their responsibilities and expectations. The subsequent sections describe the agreements established to be adhered to throughout the project.

9.1.1 Documentation

STEEL-ALIVE relies on two key contracts: the Grant Agreement and the Consortium Agreement. The Grant Agreement outlines the rights and obligations of both the beneficiaries and the European Commission concerning the project, while the Consortium Agreement governs the rights and responsibilities shared among the beneficiaries themselves during project implementation. Together, these documents serve as critical framework guiding the project's development.

The **Grant Agreement** specifies essential aspects such as the activities to be carried out, project timeline, total budget, financial rates and costs, the EU's contributions and all relevant rights and obligations. Typically, this document is organised into five annexes that detail the following:

- Annex 1 – Description of Action (DoA)
- Annex 2 – Estimated budget of the action
- Annex 3 – Accession Forms
- Annex 4 – Model for the financial statements
- Annex 5 – Specific rules

The Project Coordinator holds responsibility for converting the proposal into the technical annex (Annex 1). This section, deemed the most vital, is structured into two parts:

- **Part A:** Contains the work plan tables.
- **Part B:** Drawn from Part B of the application form, it contains a detailed technical description of the project.

In contrast, the **Consortium Agreement** represents a legally binding contract endorsed by all beneficiaries. It addresses partner commitments, operational coordination, internal workflows and the governance of project outcomes. This agreement is not merely a procedural requirement; it plays a significant role in mitigating risks and facilitating successful achievement of project goals, particularly when challenges emerge during or after implementation.

The Consortium Agreement comprises various sections and clauses regulating several aspects, including:

- **General provisions:** Identification of partners, purpose and contract duration.
- **Responsibilities:** Technical obligations and result management.
- **Organisational structure:** Meetings, voting systems and decision-making processes.
- **Economic provisions:** Budget allocation and payment terms.
- **Ownership of results:** Ownership rights and management strategies.
- ...

9.1.2 Management structure

For its part, the management framework is built on four key pillars: (i) compliance with contractual obligations, (ii) decision-making driven by prioritisation, (iii) promotion of high-quality research and innovation and (iv) assurance of project impact. In alignment with these principles, the consortium's organisational structure is defined through the following governing bodies:

- **General Assembly (GA):** Acting as the main strategic decision-making body, the GA is responsible for overseeing progress, implementing corrective actions and resolving conflicts. Led by CIDAUT, its focus spans four primary areas: (i) overall project supervision, (ii) monitoring technological progress, (iii) managing intellectual property rights (IPR) and dissemination activities and (iv) overseeing exploitation strategies.
- **Project Coordinator:** This role serves as the central link between the project and the EC. Key responsibilities include ensuring timely submission of deliverables, fostering coordination within the consortium and overseeing risk management processes.
- **Work Package Leaders (WPLs):** Charged with the management of work packages, WPLs work to achieve milestones and deliverables within defined budgets. They are also responsible for reporting any disruptions or delays to the Project Coordinator to facilitate swift resolution. Within STEEL-ALIVE, WPLs are required to provide monthly update on achievements made.
- **Task Leaders (TLs):** They are entrusted with supervising tasks to ensure timely delivery and smooth execution. In addition, they inform their respective WPLs of potential risks, facilitating effective communication and coordination.

This organisational setup foster collaboration at all levels, leveraging expertise across the consortium to meet project goals.

9.2 Project meetings

To ensure a consistent and well-organised exchange of information, a structured schedule of interactions has been established as part of the project. The Project Coordinator is responsible for implementing this plan and ensuring it remains up to date (see Table 4 for more details).



Table 4. Overview of the project meetings

Meeting	Frequency	Participants	Objectives
Kick off	A one-day F2F meeting at the start	All partners	Initiate the project and address administrative and financial matters. Review and approve the work plan and timing.
General Assembly	5 F2F meeting every 6 months, each lasting 2 days	All partners	Monitor the progress of the project's development.
Periodic review meetings	Monthly	All partners	Revision and discussion of technical activities and outcomes. Coordination between WPs. Assessment of budget-related matters.
WP & Task meetings	Variable frequency	WP/Task leaders and participants	Discuss technical aspects, methodologies and outcomes achieved. Track and evaluate the progress. Facilitate collaboration and establish connections with other WPs and tasks.
Final meeting	A two-days F2F meeting at the end of the project	All partners	Review of the project's achievements and milestones. Agreement on the strategy to ensure the continuity of the outcomes.

Wherever possible and appropriate, online meetings will take precedence over in-person gatherings to promote broader participation from all partners. On the other hand, for each meeting, the hosting partner or organiser will be responsible for managing the administrative and planning expenses (for face-to-face meetings), preparing the agenda and ensuring it is shared with the Coordinator. In turn, CIDAUT, in collaboration with the hosting partner, will consistently handle the drafting of the meeting minutes.

9.3 Project repository

By the same principle of ensuring a seamless flow of information, the Coordinator has enabled a collaborative workspace in MS Teams. This platform allows every partner to participate actively in discussions, contribute to content creation and collaborate in real time on shared documents.



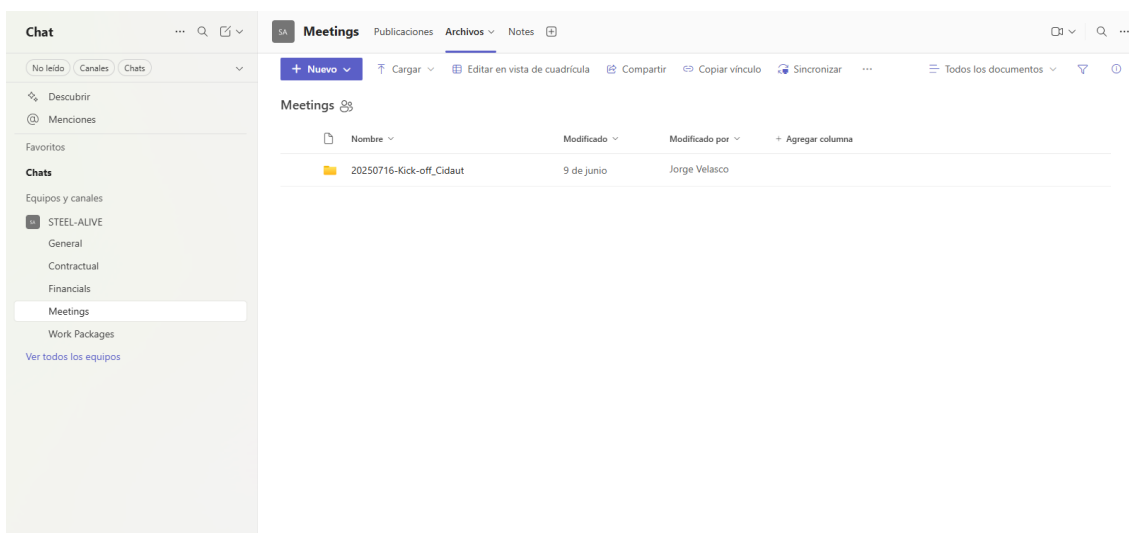


Figure 5. Preview of the MS Teams Area

Regarding the organisation, each WP has a specific channel where partners can post messages, share comments and upload the files related to that particular WP. For a detailed overview of the available channels and their purposes, refer to Table 5.

Table 5. List of channels into which the MS Teams Area is structured

Channel Name	Description	Primary audience	Access rights
Contractual	Contractual documents	All members	All members
Financials	Project Financials	Financial Officers	All members
General	General documentation for the Consortium	All members	All members
Meetings	Documentation generated during meetings, such as presentation slides, agendas and minutes	All member	All members
Work Packages	All deliverables, shared documents, planning details and posts related to the progress of WPs should be included here	Partners involved in the WPs	All members

Only CIDAUT, as the sole administrator, have the rights to create or delete channels. Should a partner require the creation of a new channel, they must notify the Coordinator to maintain proper traceability.



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