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Executive Summary

The STAR project focuses on the development, deployment, and validation of trusted and human-centred AI systems for manufacturing applications. The project's AI systems will be developed and validated in the scope of user-driven applications in realistic settings such as production lines in factories and pilot plants. STAR's validation scenarios will be developed based on co-creation approach, which will be based on user studies involving all relevant stakeholders.

This document summarizes the user-study methodology, which specifies the user-studies and co-design sessions contributing to the achievement of a human-centric AI. A series of co-creation workshops will be conducted at the three pilot sites, allowing a number of different stakeholders to play an active role in all phases of the project by proposing ideas and providing suggestions. These phases include: (1) definition and design; (2) early development and testing; and (3) final development and testing. Different aims are formulated for each workshop in each phase. There will be 9 workshops in total, one workshop per pilot for each phase.

In phase 1, the functional and non-functional requirements, user stories and task scenarios will be evaluated and co-created. Workshops in phase 2 will focus on the evaluation of the interim version of the pilot systems, and workshops in phase 3 will focus on the final version of the pilot systems. Evaluation and co-creation activities will address ,for example, system usability, achievement of design criteria and the provision of general feedback.

The feedback and insights of each workshops is synthesized and provided to relevant project partners for further improvement of the pilot systems.

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Definitions, Acronyms and Abbreviations

Acronym/ Abbreviation	Title
AI	Artificial Intelligence
CPPS	Cyber Physical Production Systems
HCI	Human-Computer Interaction
WP	Work Package

1 Scope and Introduction

The achievement of human-centricity, safety and trust has been defined as key success criteria for the development of AI technologies in the STAR project. To drive their development, and measure the successful achievement of aspired success criteria, this methodology will specify the user-studies and co-design sessions, including their evaluation. In participatory design processes, users play an active role in all phases of the project by proposing ideas and providing suggestions. As opposed to solely assessing the software artifact, users actively and directly participate in the design process activities through shared experimentation, mutual learning and reflection [1, 2]. Each pilot site will conduct a number of co-design sessions throughout the design, development and testing process of the AI technology, facilitating participation to a feasible extent. By means of multiple methods and tools, input and feedback will be collected and synthesized for relevant stakeholders. The project co-ordinator's agile development process will ensure that resulting requests for changes of the software are incorporated at the interim and final release. To increase the studies validity, each session will include multiple stakeholders to assess and validate the technical artifacts throughout their development cycle.

1.1 Document Structure

The structure of the document is as follows. Section 2 presents the criteria for the design of the pilot systems, against which the success of the project in terms of human factors and operational factors will be measured. Section 3 specifies the detail of the user studies. Section 4 concludes.

2 Human – technical & AI systems co-operation

2.1 Socio – technical system interaction model

Human – technical systems co-operation aims to make best use of both human and technical system capabilities. While the human factors has long been recognised as a key aspect of sociotechnical systems [3] and are explicitly considered as part of Human Computer Interaction (HCI) models, the introduction of Industry 4.0 technologies in industrial workplaces place an ever higher emphasis on the need to understand the interactions between human and technical actors in production environments [4]. While cases of technical actors aiding humans in such workplaces are highlighted by numerous applications, the opposite, i.e. humans aiding technical actors, also holds significant potential, enabling human cognitive abilities to be integrated in sociotechnical systems [5]. This is now increasingly being studied in the case of AI systems included as part of the technical environment in cyber-physical production systems (CPPS) [6]. Accordingly, there is a need to explicitly take into account the human – technical & AI systems interaction when determining the architecture of sociotechnical systems [7]. There is a strong motivation in the STAR project to understand this interaction early on and account for it in the STAR architecture.

The concept of this interaction is outlined in Figure 1, wherein a technical actor can be an operational (e.g., machine, device, control) or IT (software component, AI agent, etc) one. Human and technical actors have human and technical capabilities respectively. Both use their capabilities to have an impact on the socio technical system. Additionally, the technical capabilities of technical systems empower humans to perform additional or enhanced activities and provide feedback (data, information, etc) to them. So human capabilities are influenced by technical systems, including learning from the provided data or information.

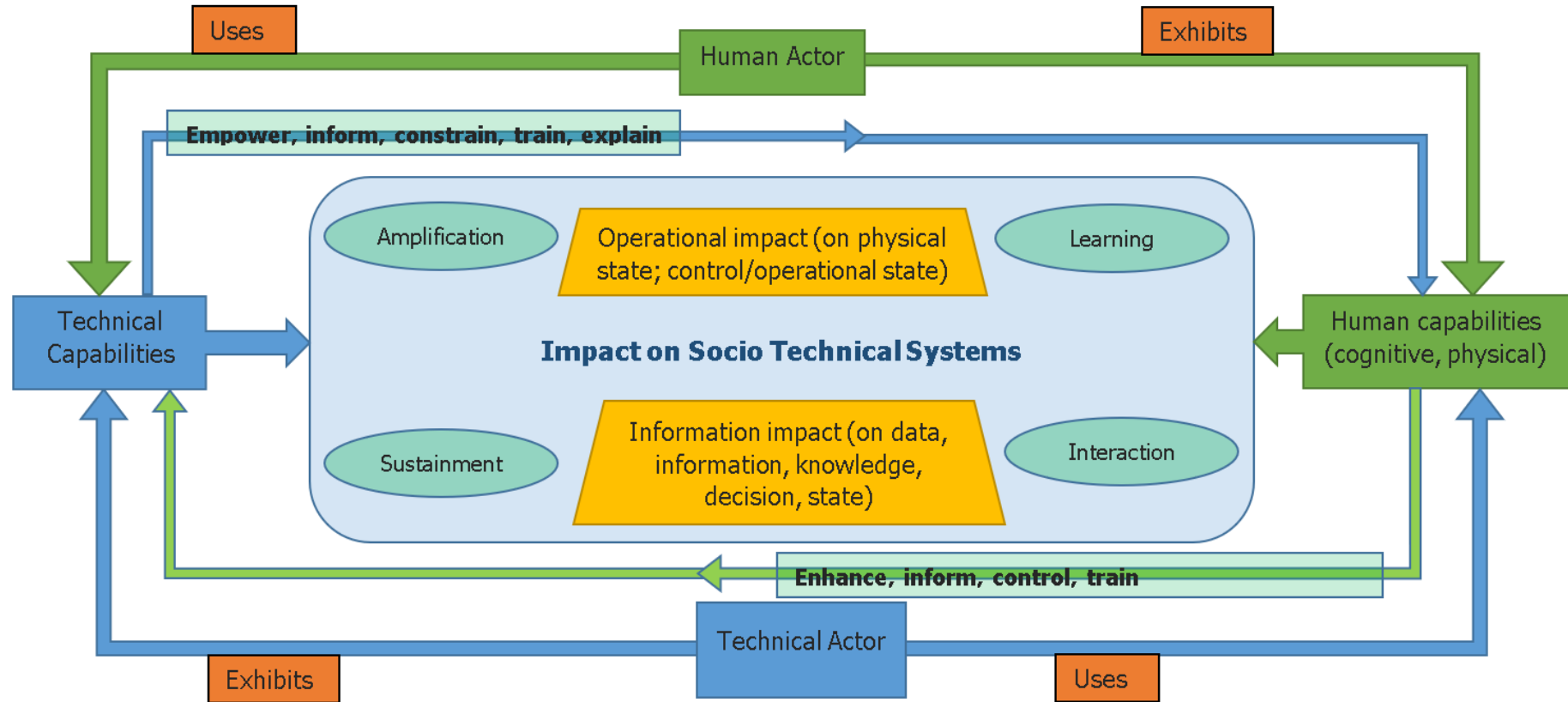


Figure 1 Socio – Technical System Interaction Model

2.2 Success Criteria

Table 1 provides an overview of the success criteria against which the success of the project will be measured. These are therefore considered also as design criteria and are feeding into the user studies and co-creation workshops, as well as in the system evaluation. The criteria might differ per pilot case depending on the goals and requirements of the stakeholders, and aim to serve the STAR objectives and target developments, e.g. developing safe, trusted, explainable and human-centric AI systems. To the best of our knowledge, there is currently a lack

of a unique and established methodology that provides a comprehensive overview of the design criteria of AI systems with humans in the loop. Therefore, Table 1 provides a preliminary overview of criteria focused on human and operational factors, drawn from earlier studies on guidelines and principles for the design of AI systems (e.g. [3] for related work). The final identification and validation of the success criteria per pilot will be conducted in workshop 1, corroborated by a comprehensive synthesis of the literature. This report outlines the types of criteria but their detailed definition and means of measurement will be part of other project tasks, and will be taken into account in the evaluation methodology (Task 6.6). The workshops will provide valuable stakeholder’s input to the detailed criteria definition per pilot case.

Table 1. Success criteria

Categories	Criteria	Definition	Means of how criteria can be defined	Measurement
Human Factors	Engagement	Extent to which human and AI actors act in synergy to jointly advance their capability and capacity, for the benefit of the sociotechnical system that they are part of	Will be defined as part of the system requirements, pilot cases’ needs, co-creation workshops, and system and component design. (indicatively, can include questionnaires, interviews, observations)	Will be defined in the evaluation methodology
	Trust	Extent to which human actors trust system / methods outcomes. (This is a human perception-oriented definition of trust: trustworthiness in industrial systems can have other definitions)	Will be defined as part of the system requirements, pilot cases’ needs, co-creation workshops, and system and component design. (indicatively, can include questionnaires, interviews, observations)	Will be defined in the evaluation methodology
	Intrusiveness	Extent to which system / methods are considered intrusive by human users and/or experts	Will be defined as part of the system requirements, pilot cases’ needs, co-creation workshops, and system and component design. (indicatively, can include questionnaires, interviews, observations)	Will be defined in the evaluation methodology
	Likeability	Extent to which system / methods are perceived as likeable by human users and/or experts	Will be defined as part of the system requirements, pilot cases’ needs, co-creation workshops, and system and component design (indicatively, can include questionnaires, interviews, observations)	Will be defined in the evaluation methodology
	Low cognitive	Extent to which system / methods cause	Will be defined as part of the system	Will be defined in the

	overhead	cognitive overhead on human users and/or experts	requirements, pilot cases' needs, co-creation workshops, and system and component design. (indicatively, can include questionnaires, interviews, observations)	evaluation methodology
	Low physical overhead	Extent to which system / methods cause physical overhead on human users and/or experts	Will be defined as part of the system requirements, pilot cases' needs, co-creation workshops, and system and component design. (indicatively, can include questionnaires, interviews, observations, including human state identification measurements)	Will be defined in the evaluation methodology
	Safety	Extent to which system / methods are considered safe. Of interest are: (a) perceived safety by humans (b) safety expressed through safety cases	Will be defined as part of the system requirements, pilot cases' needs, co-creation workshops, and system and component design. (indicatively, can include questionnaires, interviews, observations, and safety test cases)	Will be defined in the evaluation methodology
	Ease of use	Extent to which system / methods are perceived to be easy to use by human users and/or experts	Will be defined as part of the system requirements, pilot cases' needs, co-creation workshops, and system and component design. (indicatively, can include usability tests).	Will be defined in the evaluation methodology
	Explainability	Extent to which the decision process and outcomes of AI are understood by human users and/or experts.	Will be defined as part of the system requirements, pilot cases' needs, co-creation workshops, and system and component design. (indicatively, can include explanation questionnaires and tests)	Will be defined in the evaluation methodology
	Security	Extent to which system / methods are perceived to be secure by human users and/or experts (Perceived Security) System and component security risks,	Will be defined as part of the system requirements, pilot cases' needs, co-creation workshops, and system and component design (indicatively, can include questionnaires,	Will be defined in the evaluation methodology

		inclusive of threats, vulnerabilities, likelihood of risks and their potential impact on systems and humans.	interviews, observations, and protocols for security penetration testing)	
	Enriched jobs	Job enrichment is a type of job 'redesign'. It is achieved by designing jobs with certain knowledge, social and motivational characteristics This includes e.g., job autonomy, skill variety, intrinsic feedback, problem solving, task variety, social support.	Will be defined as part of the system requirements, pilot cases' needs, co-creation workshops, and system and component design, and will consider work outcomes, such as motivation, satisfaction, commitment, job involvement, burnout/stress, anxiety, etc. (indicatively, can include questionnaires, interviews, observations)	Will be defined in the evaluation methodology
Operational Factors	Process Quality	Pilot – specific definitions	Will be defined as part of the system requirements, pilot cases' needs, co-creation workshops, and system and component design	Will be defined in the evaluation methodology
	Process Efficiency	Pilot – specific definitions	Will be defined as part of the system requirements, pilot cases' needs, co-creation workshops, and system and component design	Will be defined in the evaluation methodology
	Process Flexibility	Pilot – specific definitions	Will be defined as part of the system requirements, pilot cases' needs, co-creation workshops, and system and component design	Will be defined in the evaluation methodology
	Costs	Pilot – specific definitions	Will be defined as part of the system requirements, pilot cases' needs, co-creation workshops, and system and component design	Will be defined in the evaluation methodology

3 STAR-pilots user studies specifications

This section will specify the overall user studies of the project. The final details of these specifications regarding the individual workshops in each phase will be produced by the pilot partners taking into account the use case context. An overview of the required tasks, the responsibilities and the deadlines is provided in section 3.8.

We distinguish between two main phases in which workshops will be conducted, namely (1) definition and design (2) and development & testing.

During the definition and design phase, the requirements of the project's use cases are clearly specified and detailed into user stories/use cases. Moreover, success criteria will be identified and validated. Users and technology providers will be engaged in the definition phase by means of co-reaction workshops and focus groups. During the development and testing phase of the technology, functional requirements will be translated into mock-ups and working prototypes. By means of focus groups and co-creation workshops, these prototypes will be evaluated to better understand users' experiences and viewpoints, the real-world context, and the technology's usability. This will be achieved for the first version of the pilot systems (early development and testing phase) and the final version of the pilot systems.

3.1 Types of workshops and their objectives

Workshops will be held for both the **definition and design**, as well as the two **development and testing** phases at each pilot site throughout M1 to M27. The development and testing phase workshops will contain an evaluation part (focus groups) and a co-creation part. An overview of the workshops and their goals can be seen in Figure 3.

3.1.1 Definition and Design Phase Workshops (W1)

W1 will be planned for months 5 or 6 during the definition and design phase of the AI technology and the pilot user scenarios. In the first part of the workshop, participants will validate and evaluate the functional and non-functional requirements and user stories in a focus group, and then in the second part they will co-create different collaboration scenarios based on the relevant success criteria. Scenarios address approaches regarding how (1) humans can help/augment the AI, (2) where AI technology can help/augment humans, and (3) the optimal interaction (see Figure 1 and Figure 2). Participants can propose, represent, interrogate and reflect on the different scenarios, while proposing ideas and visions which are based on the actual use context, and propose importance/priorities for different criteria.

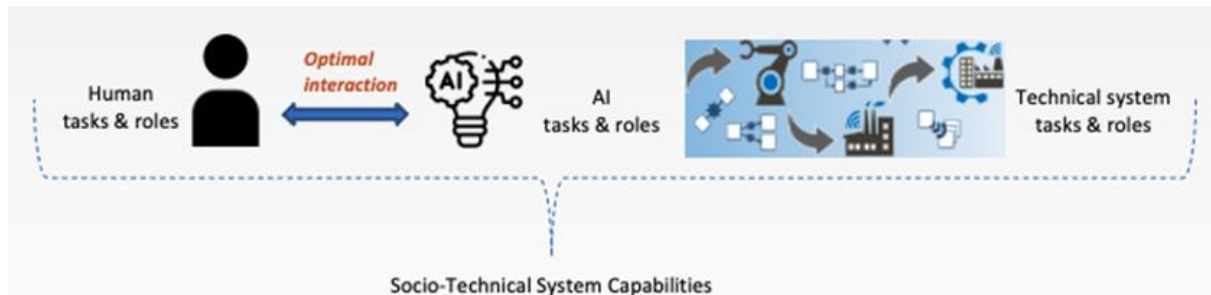


Figure 2 Mapping socio-technical systems capabilities

To corroborate this workshop, **a survey will be distributed in M3** among stakeholders, identifying the envisioned success criteria of the AI technology.

3.1.2 Early Development and Testing Phase Workshops (W2)

During W2 co-creation and evaluation activities will be undertaken addressing the functionalities of the first version of the pilot systems available (Early Design and Development). Participants will visualize, simulate and experiment with the pilot system, supported by mock-ups and prototypes. Based on that, participants can develop and propose improvement ideas and system testing scenarios. Moreover, the usability targets and success criteria will be evaluated. The workshop **is planned in month 21** of the project, after delivery of D6.5, D.6.7 and D6.9 of work package 6 (Interim version prototype implementation of pilot systems)

3.1.3 Final Development and Testing Phase Workshops (W3)

The content and focus of Workshops W3 are similar to W2, but the co-creation and evaluation activities will be focused on the final version of the pilot systems. In addition to the aims of W2, the final workshops will additionally propose final user testing scenarios, as well as usage scenarios for wider stakeholders external to the project. Workshops W3 will be planned for M26 to provide sufficient impetus and time for acting upon their outcomes, a few months before the delivery of D6.6, D6.8 and D 6.10 (final prototype implementation of pilot systems).

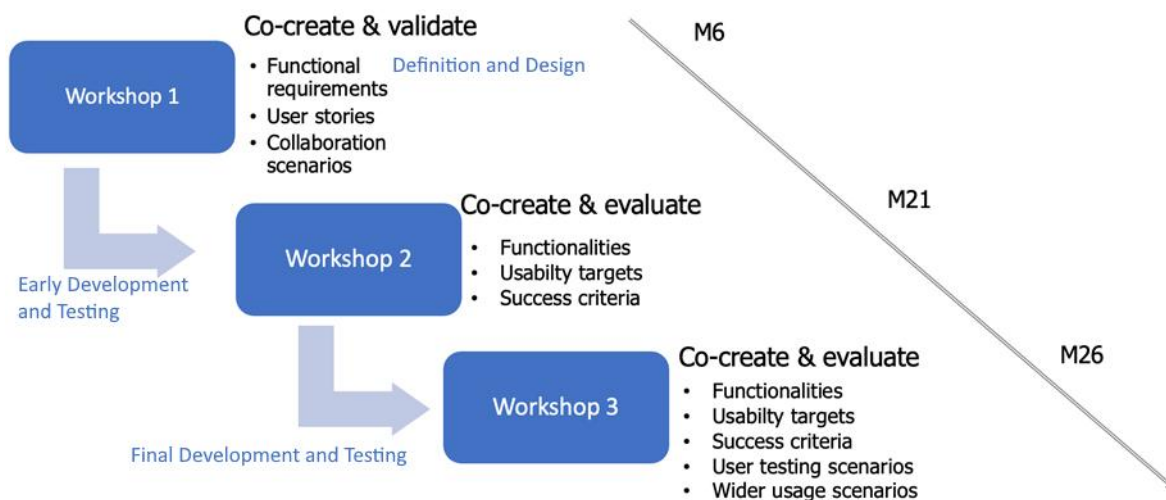


Figure 3 Workshops and objectives per pilot

3.2 Timeline and relation to other relevant WP

Figure 4 illustrates the dependencies of the workshops in relation to other work packages. The dependency derives from the planned delivery dates of components which are required as input for the scheduled workshops. Important input is needed from WP2 and WP6, and the workshop will provide important output for the technical systems of WP4, WP3 and WP5. The delivery date of D2.2 (reference scenarios and use cases), and of D6.6, 6.8 and D6.10 (final prototype implementation) are planned after the date of the first, and third workshop, respectively. Therefore, task leaders of the WP are asked to **provide a preliminary version of their delivery** as input for the workshops. This is applicable for workshop 1 and workshop 3.

Figure 4 Timeline for workshops & deliverables

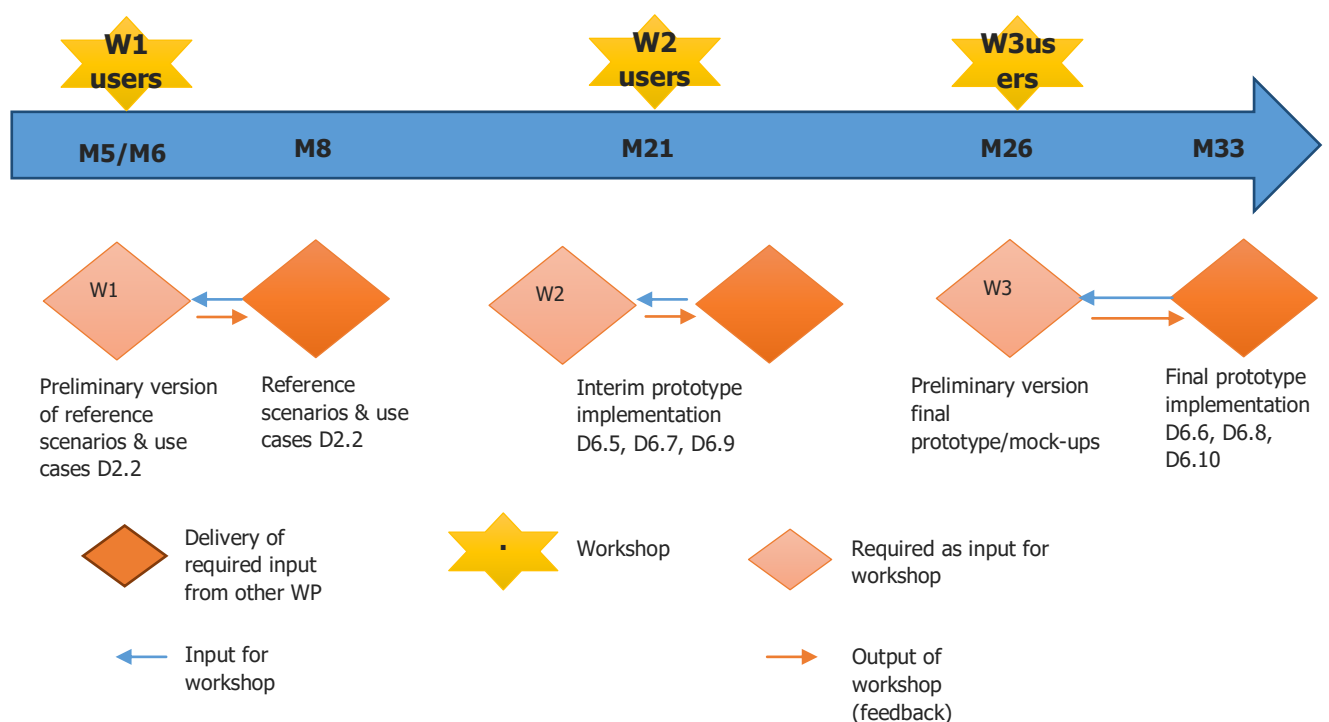


Figure 5 Timeline for workshops & deliverables

3.3. Workshop participants

The selection of suitable participants is crucial for the success and effectiveness of the co-creation workshops. The responsible from the three pilot partners will be in charge of a thorough participant selection and the invitation process, together with the task leader as specified in T6.1 (DFKI).

3.3.1. Number and types of participants

The number of participants should be based on

- Having representation from each stakeholder group (one participant per group)
- Allowing each participant to have sufficient time to participate and contribute; having a participation within the range of 8-15 participants would be well aligned with this target.

The list next provides different stakeholder groups that could be involved:

3.3.1.1. Primary stakeholders

Future users/beneficiaries

- Operational staff (current & prospective users)
- Production managers, quality managers
- Engineering/maintenance staff
- Supervisors, team-leads (middle management)

Other organizational members

- Representatives of the work council (representatives of users)
- HR representatives (of pilot site)

STAR project partners

- Developers of the technological components

3.3.1.2. Secondary stakeholders

- Experts in the fields of AI
- HR-Human factors experts
- Industry representatives
- Legal experts
- Other organizations (future prospective users)
- Co-competitors
- Suppliers

3.3.2. Selection criteria

The quality of the workshop depends on the participants selection, emphasizing the importance of achieving a well-balanced mix of participants. Therefore, each workshop organizer (the pilot case lead) will set up participant profiles outlining the attributes of the participants. A number of key aspects that should be considered are listed in Table 2.

Table 2. Workshop participants selection criteria

Selection criteria	Explanation
Motivation and attitude towards the project	The participants should be interested in attending the workshops. Involving participants with strong interest in the subject matter, could be a strong incentive and ensure engagement. Thus, the participant selection will be based to a great extent on their intrinsic motivation.
Experience with the subject matter	Participants should display different levels of experience in and connection to the subject of the workshop in order to ensure that we integrate various viewpoints.
Actual role in the project	Workshop organizers should take into account the representative's connection to the subject matter.
Work experience	it is useful, especially looking at participants from the pilot context, to consider the work experience, influence and seniority of the participants

Based on the criteria, the organizer will develop a list of workshop attendees, and a reserve list of participants. To ensure comprehensiveness, the list will be verified by the WP6 leader, in consultation with the pilot leaders and the responsible for the development of the human-centric methodology (RuG, WP2, T2.6).

3.3.3. Inviting the participants

After defining the selection criteria and identifying the participants, the organizer of the workshops will send out the invitations well in advance. The invitation will include a preparatory letter providing the invitee with the essential information regarding the workshop, its objectives and the overall structure. A deadline for confirmation should be set, typically 2-4 weeks before the workshop.

3.4. Workshop format specification

The workshops will be following a co-creation format containing co-creation activities and evaluation activities depending on the goal of the workshop. Next, the structure of the workshops, the potential methods for its execution, and the tools (for execution of the workshop) are addressed. A draft agenda for the Definition and Design workshop (W1) is developed and can be seen in an Appendix. The agendas for the W2 and W3 workshops, including the structure and methods will be developed prior to the workshops, by each pilot lead, in consultation with the WP6 lead and the partner responsible for the development of the human-centric methodology (RuG, WP2, T2.6).

3.4.1. Structure

The workshops will generally follow a three-phase structure, however can be tailored to the specific workshop activities.

Adequate time for the execution of the different workshop activities should be allowed. However, it is important to keep the activities within a reasonable time limit as to prevent fatigue. For example, the workshops will be spread into equal sessions allowing breaks

between them, including a long break in between (1 to 1.5 hours). If necessary, workshops can be spread over two consecutive days to prevent too long days.

The proposed structure is as follows:

Introduction

During the introduction of the workshop, participants will be introduced to the main subject matter of the workshop, its goals, expectations and activities. This can be achieved through a short presentation from the organizer of the workshop. Sufficient time should be awarded for people to get to know each other and 'break-the ice', e.g., by means of standard personal introductions, pair introductions or other methods.

Main phase

During the main phase of the workshop, the main objectives of the workshops are to be achieved by means of different methods:

Evaluation

During the evaluation phase, key findings of the workshops will be discussed and evaluated based on their feasibility and priority. The workshop should conclude with a clear evaluation if the goals of the workshops have been met. Participants should be informed about how the findings of the workshop will be used in the project, and how findings will be communicated.

3.4.2. Methods and activities

During each workshop, co-creation activities and focus group activities will be conducted. The final selection of suitable methods will be defined a month prior to the workshop, and depends on the content and goal of the workshop.

Examples of co-creation methods:

- Process simulations [8]
- Design games [9]
- Prototyping ([10]
- Storytelling [2]
- Design thinking [11]
- Virtual collaboration tools (such as Jamboard, Miro, or Mural)

The final specification of the focus group activities will be agreed between the workshop organiser (pilot lead) and the WP6 lead, in consultation with the partner responsible for the development of the human-centric methodology (RuG, WP2, T2.6).

3.4.3. Tools

Different tools will be deployed at every phase to collect user's feedback, reflections and perceived usability.

W1: Workshop 1:

The workshop will most likely be held online due to the current COVID19 restrictions. Examples of online collaboration tools to use include:

- Mural (<https://www.mural.co>)
- Miro (<https://miro.com>)
- Jamboard ([Jamboard.google.com](https://jamboard.google.com))

To capture co-creation behaviours and overall co-creation results, the following data collection tools will be developed:

- Observation sheets to capture co-creation behaviour
- Feedback form to obtain participants feedback regarding task scenarios and user stories
- Survey to assess the main aspects of the workshop, including an overall evaluation of the event

W2: Workshop 2:

- Observation sheets to capture co-creation behaviour
- Feedback form to obtain participants feedback regarding first version of the pilot systems (Early Development and Testing)
- Survey to identify performance regarding usability metrics & success criteria
- Survey to assess the main aspects of the workshop, including an overall evaluation of the event

W3: Workshop 3:

- Observation sheets to capture co-creation behaviour & feedback
- Feedback form to obtain participants feedback regarding final version of the pilot system (Final Development and Testing)
- Survey to identify performance regarding usability metrics & success criteria
- Survey to assess the main aspects of the workshop, including an overall evaluation of the event

3.4.4. Workshop facilitators and moderators

During each workshop, a main facilitator and moderator will be present. The facilitator is responsible for leading and executing the workshop and is supported by a team of moderators. The moderators will support the facilitator in facilitating and guiding the individual activities. Moderators are then made responsible for the application of the co-

creation methods and focus group exercises, in charge of the process and the group dynamics of the workshop. They should support all the participants in order to express their opinion and ensure that some participants do not monopolize the time and the discussions. During the workshop the moderators will explain the chosen activity, monitor compliance with the rules and stimulate the discussion. Participation of additional support staff is likely to be needed.

3.4.5. Follow up activities

After each workshop, a report will be drafted by the pilot lead and the T2.6 lead (RuG), with a synthesis and analysis of the workshop outputs (see also section 3.5). The primary content for the report will be provided by the workshop facilitator and the workshop organiser, and the report will be led by the T2.6 lead. The report will address the following aspects:

- Introduction sketching the objectives, brief summary of the structure, its proceeding and overall success
- Agenda of the workshop
- Description of the participant’s profile
- Description of the workshop’s sessions, discussions and outcomes
- Description of the co-created concepts / focus groups outputs per session
- Results from the evaluation of the workshop
- Conclusion

At the end of the workshop, participants will be asked to fill out a survey which will assess the main aspects of the workshop, and also includes an overall evaluation of the event.

These surveys will be distributed at the end of the workshop, so that participants can complete them before leaving. Completing the questionnaire shall not take longer than 10 minutes.

3.5. Planning workshops and their targets

The workshops will constitute one working-day event. Their actual duration will be determined by their objectives and can therefore vary. Depending on the status of the developed technology and the date of the workshop, the two workshops planned during the development and testing might be organized as one larger event per pilot (Table 3).

Table 3. Workshop planning and targets

Co-creation workshops	Project month	Workshop target
Pre-Workshop 1 (Survey)	M3	<ul style="list-style-type: none"> • identify relevant success criteria of pilot cases involving all project partners
Definition and Design Workshops (W1)	M5/M6	<ul style="list-style-type: none"> • Validate requirements • Validate user stories

		<ul style="list-style-type: none"> • Co-create task scenarios
Early Development and Testing Workshops (W2)	M21	<ul style="list-style-type: none"> • Co-create testing scenarios • Obtain early feedback from stakeholders (testing and validation)
Final Development and Testing Workshops (W3)	M26	<ul style="list-style-type: none"> • Final testing and validation scenarios • Assess future prospects and suggest areas for further development within and beyond the project

3.6. Required input and output of workshops

To successfully prepare and execute the workshops, required input and output will be defined. The input described what is needed during the workshop, whereas output refers to the envisioned results of the workshops. The input and output requirements vary per product phase and goal of the project (Table 4). Finally, the last column of Table 4 provides an overview of the tasks where the workshop output will be fed as input.

Table 4. Input and output requirements

Workshop	Required input workshop	Required output workshop	Input for
Workshop 1	Preliminary version of: <ul style="list-style-type: none"> • Functional requirements • User stories • Task scenarios 	<ul style="list-style-type: none"> • Validated requirements and user stories • Feedback on task scenarios 	<ul style="list-style-type: none"> • WP2 (T2.1., T2.2.) • WP3 • WP4 • WP5
Workshop 2	<ul style="list-style-type: none"> • Mock-ups • Prototype initial version incl. task and scenario descriptions 	<ul style="list-style-type: none"> • Updated requirements to be assessed in subsequent pilot development • List of feedback and suggestions which will influence refinement of requirements and specifications • Feedback scoring usability metrics & success criteria 	<ul style="list-style-type: none"> • WP2 (T2.1., T2.2.) • WP3 • WP4 • WP5 • WP6 (T6.6.)
Workshop 3	<ul style="list-style-type: none"> • Preliminary version of final prototype incl. mock-ups and testing scenarios 	<ul style="list-style-type: none"> • Updated requirements to be assessed in final pilot development • List of feedback and suggestions, which will influence refinement of requirements and specifications, and will include suggestions for beyond the project users' scenarios • Feedback scoring usability metrics & success criteria 	<ul style="list-style-type: none"> • WP2 (T2.1., T2.2.) • WP3 • WP4 • WP5 • WP6 (T6.6.)

3.7. Specification for pilot cases

To prepare for the workshops, pilot case leaders define pilot-specific workshop specifications, taking into account the proposed structure of section 3.3 to 3.5, tailoring it to the needs of each pilot case. A template is prepared in the Appendix D. The following aspects will have to be addressed:

- Description of process to be included in the pilot including a list/description of actors (human stakeholders or technical system actors) and their role in the process (As Is situation) (provided by each pilot lead, indicative length: half page)
- List of proposed relevant stakeholders to participate in the workshop, including also their role/job function and/or expertise (from the pilot partner and/or pilot partner business relationships) (provided by each pilot lead)
- List of proposed project partner stakeholders to participate in the workshop (provided by the project coordinator)
- Proposed date(s) for the workshop (provided by the pilot lead)
- User stories (provided by the WP2 lead)
- Proposed workshop format specification (structure, method and tools)

3.8. Summary tasks & responsibilities pilot specifications

Table 5 summarizes the tasks and its responsible partner of the project. Task 1 to 3 will be addressed in the specification of the pilot cases prepared for each individual workshop. For its preparation, a template is provided in the Appendix D.

Table 5 Summary of tasks & responsibilities

Task	Responsible	Deadline activity
1 Description of process to be included in the pilot including a list/description of actors (human stakeholders or technical system actors) and their role in the process	<ul style="list-style-type: none"> • Pilot leaders: 6.3 (PLC) 6.4 (DFKI) 6.5 (IBER) 	<ul style="list-style-type: none"> • 1 months prior to workshop • Workshop 1: April 2021 • Workshop 2: August 2022 • Workshop 3: January 2023
2 Workshops participants selection & invitation (section 3.3)	<ul style="list-style-type: none"> • Task leader WP6 (DFKI) • Pilot leads (DFKI, IBER, PLC) • (consultation role) Leaders of WP2 T2.6 and project coordinator 	<ul style="list-style-type: none"> • 1 months prior to workshop • Workshop 1: April 2021 • Workshop 2: August 2022 • Workshop 3: January 2023
3 Workshop format specification (section 3.4) incl. proposed date for workshops	<ul style="list-style-type: none"> • Task leader WP6 (DFKI) • Pilot leads (DFKI, IBER, PLC) • (consultation role) Leaders of WP2 T2.6 and project coordinator 	<ul style="list-style-type: none"> • 1 month prior to workshop • Workshop 1: April 2021 • Workshop 2: August 2022 • Workshop 3: January 2023
4 Delivery of required input for workshop (section 3.6)	<ul style="list-style-type: none"> • Workshop 1: Task leader 2.2 UNP (user stories) • Workshop 2: Task leaders 6.3 (PLC), 6.4 (DFKI) and 6.5 (IBER), coordinated by DFKI • Workshop 3: Task leaders 6.3 (PLC), 6.4 (DFKI) and 6.5 (IBER), coordinated by 	<ul style="list-style-type: none"> • 2 weeks prior to the workshop

		<p>DFKI</p> <ul style="list-style-type: none"> • WP2-WP5 leads regarding mock-ups / components for user feedback / evaluation 	
5	Follow-up activities (section 3.4.5)	<ul style="list-style-type: none"> • WP2 T2.6 (lead) • Pilot leads (DFKI, IBER, PLC) for content 	<ul style="list-style-type: none"> • Report of workshop will be drafted within two weeks after the workshops • M9: September 2021 <p>D2.9 Report on Co-Design Workshops and Focus Groups-Initial version</p> <ul style="list-style-type: none"> • M27: March 2023 <p>Report on Co-Design Workshops and Focus Groups-Final version</p>

4. Conclusion

STAR will deploy 3 phases of co-creation/focus group workshops during M3-M27. The workshops' aim to co-design the technological concepts at the three pilot sites, and to provide different stakeholders with the possibilities to provide user's feedback through different stages of the project (definition/design, early development and testing, final development and testing). The workshops also provide an opportunity to determine the usability of the developed systems, and to assess the achievement of defined success criteria defined by the pilot sites.

This document presents key aspects that will define the workshops. More detailed workshop planning will be defined by the leaders of the pilot cases, in consultation with the leader of T2.6, and WP6 lead, taking into account input from technology development WP leads. and the project technical coordinator. This will be done prior to the execution of the pilot, leaving sufficient time to invite the stakeholders.

5. References

Reference	Name of document
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11	Razzouk, R., & Shute, V. (2012). What is design thinking and why is it important?. <i>Review of educational research</i> , 82(3), 330-348.

Appendix

A Template workshop detailed plan

For every workshop at each pilot site, a detailed plan will be developed according to the choices and preferences of the organizer.

The plan will address the following aspects:

- Scope and objectives of the workshop
- Time plan
- Facilitator and moderator team
- Participants
 - profile and number of participants
 - Invitation process
- Structure workshop
- Co-creation / Focus group methods
- Evaluation & prioritization criteria for co-creation ideas
- Venue
- Background material
- Follow up activities
- Organizational aspects

B Template workshop agenda

Table 6 provides a template agenda for the workshop. A draft agenda is presented in Appendix C. The content and focus of each session will vary depending on the objectives of the workshop, and can be co-creation activities and feedback activities.

Table 6. Template agenda workshop

Time	Activity	Summary
08:30-09:00	<ul style="list-style-type: none"> Coffee - registration 	
09:00-09:30	<ul style="list-style-type: none"> Opening of the workshop 	Welcome the participants; presentation of the STAR project and aims; Introduction to the co-creation workshop
09:30-10:00	<ul style="list-style-type: none"> Personal introduction - warm up discussion 	Ice-breaking activity
10:00-10:45	<ul style="list-style-type: none"> Session 1 - 	To be determined
10:45-11:00	<ul style="list-style-type: none"> Coffee-break 	
11:00-11.;45	<ul style="list-style-type: none"> Session 2 	To be determined
11:45-13:00	<ul style="list-style-type: none"> Lunch 	To be determined
13:00-14:00	<ul style="list-style-type: none"> Session 3 	To be determined
14:00-15:00	<ul style="list-style-type: none"> Session 4 	To be determined
15:00-15:15	<ul style="list-style-type: none"> Debrief 	Presenting the main findings/results
15:15-15.30	<ul style="list-style-type: none"> Evaluation 	Recognizing the most important and crucial ideas/solutions
15:30-16:00	<ul style="list-style-type: none"> Presenting of the results and closing 	Summarizing the main results of the workshop; thanking the participants; final comments

C Draft agenda Workshop 1

Table 7 presents a draft agenda for the Definition and Design workshop. The agenda is open for adaptations based on the detailed plans of the workshops. If necessary, workshops can also be executed over two consecutive days.

Table 7. Draft Definition and Design workshop agenda

Time	Activity	Summary
08:30-09:00	<ul style="list-style-type: none"> Coffee - registration 	
09:00-09:30	<ul style="list-style-type: none"> Opening of the workshop 	Welcome the participants; presentation of the STAR project and aims; Introduction to the workshop
09:30-10:00	<ul style="list-style-type: none"> Personal introduction 	Ice-breaking activity
10:00-10:45	<ul style="list-style-type: none"> Focus group activity 1: Discussing and validating the functional requirements 	Method to facilitate discussion; tbd at a later stage
10:45-11:00	<ul style="list-style-type: none"> Coffee-break 	
11:00-11:45	<ul style="list-style-type: none"> Focus group activity 2: Discussing and validating the user stories (different methods possible) 	Method to facilitate discussion; tbd at a later stage
11:45-13:00	<ul style="list-style-type: none"> Lunch 	
13:00-14:00	<ul style="list-style-type: none"> Session 3: Co-creating collaboration scenarios (round 1) 	Co-creation method tbd at a later stage
14:00-15:00	<ul style="list-style-type: none"> Session 4: Co-creating collaboration scenarios (round 2) 	Co-creation method tbd at a later stage
15:00-15:15	<ul style="list-style-type: none"> Debrief 	Presenting the main findings/results
15:15-15:30	<ul style="list-style-type: none"> Evaluation 	Recognize the most important and crucial ideas/solutions

D Specifications for pilot case(s) workshops

The template provided in Table 8 provides an overview of the pilot case specification required for the preparation of the workshops.

Table 8 Template specifications for pilot cases workshops

Input required	
<p>Description of process(es) & actors</p> <p>To be included in the pilot including a list/description of actors (human stakeholders or technical system actors) and their role in the process (As Is situation), indicative length: half page).</p>	
<p>List of proposed relevant stakeholders to participate in the workshop</p> <p>Including their role/job function and/or expertise (from the pilot partner and/or pilot partner business relationships).</p>	
<p>List of proposed project partner stakeholders to participate in the workshop</p> <p>Provided by the project coordinator</p>	
<p>Input requirements</p> <p>User stories (Workshop1) Provided by the WP2 lead</p> <p>Mock-ups, prototype description, description testing scenarios (Workshop 2/3) provided by WP2-WP5 leads, coordinated by WP6 lead</p>	
<p>Workshop format specification</p> <ul style="list-style-type: none"> - Structure of workshop (see section 3.4.1.) - Methods & activities (see section 3.4.2) - Tools (see section 3.4.3.) - List facilitators and moderators (see section (3.4.4.) 	