Pilot Establishment Instrument 1 Guide for Applicants

Grant Agreement No.	873087
Project Name	Smart Human Oriented Platform for Connected Factories (SHOP4CF)

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Project web address:	https://www.shop4cf.eu/
Call title:	Pilot Establishment Instrument 1
Call publication date:	3 May 2021
Pre-proposal submission deadline:	11 June 2021 17:00 Brussels time
Proposal submission deadline:	3 August 2021 17:00 Brussels time
Proposal submission platform:	http://opencalls.shop4cf.eu/call/pilot-establishment-instrument-1
Target groups:	Consortium: 2 partners, an integrator and a manufacturing company (at least one of them being an SME)
Duration of participation:	8 months
Total Call budget:	€ 600K, target: six proposals selected
Maximum budget per experiment:	€ 100K lump sum
Funding rate:	100% (non-profit), 70% (for-profit)
Keywords:	Modular automation solutions, Lean System Integration, Robotics, Augmented Reality, Visual Quality Checks, Human-Centered Production
More information:	info@opencalls.shop4cf.eu

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1. Introduction

SHOP4CF (**S**mart **H**uman **O**riented **P**latform for **C**onnected **F**actories) is an EU-funded project within the eighth framework program Horizon 2020 that aims to create an unique infrastructure for the convenient deployment of human-centric industrial applications. In the project, 20 partners develop a comprehensive software platform that already hosts a wide range of different software modules (referred to as components) that cover a broad spectrum of industrial requirements and functionalities in the context of modern, flexible, and data-rich manufacturing. Apart from the core consortium who submitted the original SHOP4CF proposal, the project is looking for additional members during the project runtime through several open calls. The first open call *Pilot Establishment Instrument 1* serves as a reality check for the SHOP4CF architecture and its components that so far have only been tested under lab conditions. Experiences from operation in industrial environments is intended to lead to valuable feedback for the SHOP4CF consortium. Moreover, the call is expected to expand the ecosystem of industrial corporates that will contribute in promoting the SHOP4CF vision by adding new technologies and appealing pilots. In this first open call, we are looking for groups of two partners consisting of a system integrator and a manufacturing company. Note that at least one partner is required to be an SME. The system integrator is in charge of implementing the pilot on the production side of the manufacturing company. To this end, the solution is required to make use of the SHOP4CF architecture and the respective components.

2. The SHOP4CF Project

The overall vision of SHOP4CF is that tomorrow's production requires both machine skills (e.g., high accuracy, precision, or persistence) and human resources (e.g., creativity, adaptability, or tactile sense). Therefore, all components considered in the SHOP4CF software platform aim at the mutual complementation of human labor and machines to improve the working conditions by:

- **Automating monotonous and/or laborious work** as well as by
- increasing human productivity through **smart assistance**.

We believe that SHOP4CF can have a strong positive impact on the labor market, as people in production are not simply replaced by automated processes, but rather gain in importance as their individual abilities find new relevance. Another outcome of SHOP4CF is the development of new set of rules, which will address novel aspects of human-robot collaboration such as **privacy**, **security**, **protection**, **legal aspects**, or **data ownership**. For facilitating rapid adoption, great emphasis is put on **user-friendliness**, **reusability**, **interconnectivity**, and **accessibility**, which is achieved mainly through the following two elements:

- **Digital marketplace**: An online marketplace comprising components, pilots, license models (there are free and commercial components), specification of the rights of use and warranties.
- **Platform**: An unique framework to conveniently deploy and develop modular components that cover a wide range of different tasks in modern manufacturing environments. The idea of achieving a high degree of reusability is similar to the open-source software movement that led to a revolution towards efficient software development. This modern approach is an appealing alternative to the conventional way of creating solutions to specific problems from scratch. For this vision to work, a highly modular approach is envisaged, from which the pilot designer can creatively select and combine modular components to address the required functionalities without being overwhelmed by technical issues during integration. We believe that

this approach can significantly accelerate human-driven innovation in the context of manufacturing process design. For realising this vision, all components are developed using a single point of integration to ensure a high degree of interconnectivity and compatibility. The basic idea of the digital platform developed in SHOP4CF is that setting up automation processes in a simple way enables the human to concentrate on the problem-solving task where their creativity is required.

SHOP4CF aims to build a holistic ecosystem that fosters communication, collaboration, knowledge, and technology transfer in a community that includes SMEs, large corporates, universities, research institutes and system integrators. It is worth noting that the intended non-classical approach of SHOP4CF involves the human as an essential part. The employed methods are state of the art and involve advanced, interdisciplinary methods.

The consortium of SHOP4CF is united by the vision of a platform that significantly increases the level of automation to maintain the competitive edge of the European manufacturing sector. Open calls are the best chance for curious organizations to join the SHOP4CF community and to become part of this vision.

3. Pilot Establishment Instrument 1

The SHOP4CF consortium creates a platform providing human-centric modular components for the process automation industry that can be deployed with minimal effort for the end user. In this context, the prevailing terminology in SHOP4CF is as follows:

- **Marketplace**: Hosting modular components and providing information regarding pilots, license models (there are free and commercial components).
- **Architecture**: Ensuring coherence and interoperability of the SHOP4CF components. The architecture provides a common template for concrete systems designed for pilots, open-call projects, etc.
- **Components**: Components can be seen as sub solutions to confined tasks. For instance, a pilot comprising a work cell usually consists of several components each providing a specific functionality. The general interfaces of the components targeted in SHOP4CF are supposed to ensure convenient integration and cross-industry usability.
- **Pilots**: Use cases that comprise a set of components.

What is the Scope of This Open Call?

The scope of this open call is to establish pilots by combining modular SHOP4CF components. To this end, we are asking applicants to form teams and build pilots that address individual needs in their own manufacturing environments. The pilots are supposed to integrate both pre-existing and new components. So far, a first set of pre-existing components developed by the initial project consortium exists (see Chapter 5 and *Appendix A: Full List of Pre-Existing Components*). As mentioned before, the applicants are asked to develop new components by following the SHOP4CF architectural specifications (see Chapter 4). Note that new components are supposed to be uploaded to the SHOP4CF Marketplace. A good balance between new components and existing components is intended and will be evaluated (see Section 11). Applications that (i) rely solely on new components or (ii) applications that solely integrate pre-existing components are not supposed to be granted in this open call.

More precisely, proposals must fulfill the following three prerequisites:

1. At least a single component is required to be developed from scratch. For this purpose, the reference architecture needs to be adopted that is introduced in Chapter 4).
2. At least a single pre-existing component is required to be adopted. Information and a list of pre-existing components can be found in Chapter 5 and *Appendix A: Full List of Pre-Existing Components*.
3. The total amount of components (new and pre-existing components) should be three or higher.

An example of the process applicants will go through during this open call is outlined in the following:

1. A manufacturing company identifies a specific challenge in their production line that requires a solution (referred to as a pilot). The manufacturer contacts a system integrator to develop and implement the pilot.
2. Instead of developing the pilot from scratch, the system integrator and manufacturer decide to make use of the pre-existing modular components that are published on the SHOP4CF marketplace. The team identifies which functionalities can be covered by existing components and which components need to be developed from scratch. The team decides to apply for the first open call in SHOP4CF to receive funding for the development and implementation of their solution. Eventually, the team applies for the first open call in SHOP4CF to receive significant funding for developing and implementing their solution.
3. To apply for the open call, the team consisting of the manufacturer and the system integrator must submit a proposal in which they outline the planned project in detail. For this purpose, the applicants select and browse the already existing component(s) (again, the adoption of at least one component is required) that partially cover the required functionalities. In addition, they propose and describe the component(s) (again, at least one new component is required) they will develop to cover functionalities that cannot be covered by existing components. The component(s) developed by the applicants will be published afterwards on the marketplace (in case the proposal is selected for funding).
4. The team prepares the proposal using the proposal template available on the open call platform (link) and following this guide. Moreover, the team submits the prepared proposal via the open call platform by the deadline (3 August 2021).
5. Optionally (this step is not mandatory but is offered as an additional service), the team can submit the pre-proposal (following the pre-proposal template also available on the open call platform) by 11 June 2021 to check whether their planned proposal is in line with the scope of the open call.

How to Develop New Components?

To fulfill the vision of SHOP4CF (building solutions by stacking modular components), strict specifciations for the component development are essential. In particular, ensuring a high degree of interconnectivity requires an uniform middleware as well as general-purpose interfaces. Please refer to Chapter 4 for more details.

How Technical Mature Should the Pilot be?

Pilots are characterized by their Technical Readiness Levels (TRL). To identify technological readiness, the EU defined the following levels:

Table 1: Technical Readiness Levels

TRL 1	Basic principles observed
TRL 2	Technology concept formulated
TRL 3	Experimental proof of concept
TRL 4	Technology validated in lab
TRL 5	Technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
TRL 6	Technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
TRL 7	System prototype demonstration in operational environment
TRL 8	System complete and qualified
TRL 9	Actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)

The pre-existing components are so far validated/demonstrated in environments with limited realism (e.g., TRL 3 – 6). Pilots that are built within this open call are supposed to feature a higher degree of technical readiness; ideally, we are looking for use cases in final production environments.

4. Architectural Aspects for the Development of New Components

The SHOP4CF architecture is a framework architecture (reference architecture), i.e. a common template for concrete systems designed for pilots, open-call projects, etc. An excerpt from the SHOP4CF architecture is provided in this section, and the full version is available on the open call platform.

In SHOP4CF, different aspects of the architectural design are considered:

- **Logical software architecture** – describes the functionality and the organization of the software modules under design, i.e. SHOP4CF core components and, in the future, new components proposed by the applicants.
- **Logical platform architecture** – describes, from the functional perspective, the organization of the underlying software and hardware, i.e., the technology assumed to be present to use the aforementioned software modules.
- **Data architecture** – describes the organization of data, in the form of data models, exchanged among the software modules.

A concrete system implementing the SHOP4CF architecture is expected, respectively, to provide functionality organized in a specific way (software architecture), to use specific underlying technology (platform architecture), and to model information exchanged among

software modules with specific data models (data architecture). Defining a usage scenario (or scenarios) for such a system is also highly encouraged.
Thie SHOP4CF architecture is not fixed and will be subject to further adjustments. If applicants found it necessary, they could propose their own extensions.

Logical software architecture

Manufacturing processes can be supported in their different phases: at design of the processes, at their execution (i.e. actual product manufacturing), and at further analysis of the execution. Moreover, processes can be supported at different manufacturing levels: at specific work cells (local level) and across work cells (global level).
The high-level logical view of the software in SHOP4CF is designed as a set of six subsystems supporting manufacturing processes in the three phases (design, execute, analyze) and at the two levels (global, local), as presented in Figure *1*. Each subsystem consists of a set of concrete software components.

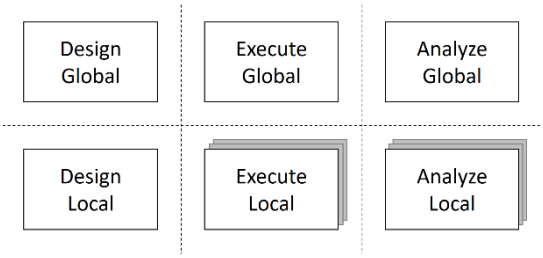

Figure 1: Top-level logical software architecture

A concrete system implementing the SHOP4CF architecture provides functionality that can be categorised into those phases and levels, and uses a subset of existing software components.
The applicants are encouraged to design how the proposed functionalities map onto the logical software architecture to ensure their alignment with the SHOP4CF framework.

Logical platform architecture

The top-level organization, from the functional perspective, of underlying technology is presented in Figure 2. The software modules under design (i.e. SHOP4CF components and, in the future, new components proposed by the applicants) use middleware for communication, may communicate with 3rd-party systems and IoT (preferably via the middleware), and run in containers (i.e. OS-level virtualization).

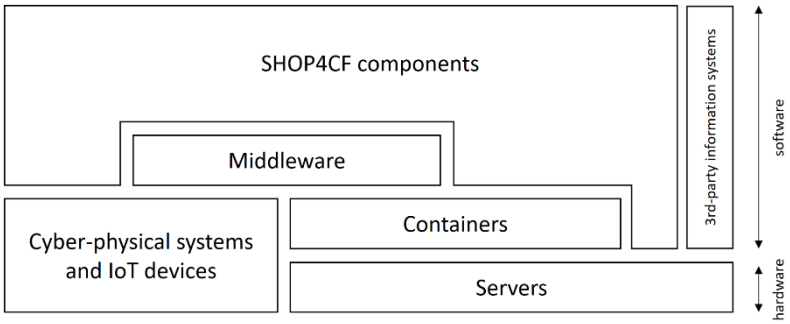

Figure 2: Top-level logical platform architecture

The adopted middleware is FIWARE. Orion-LD is the chosen implementation of the FIWARE Context Broker. All communication between software modules (components) should be

realised via the FIWARE middleware. Only in case of hard real-time constraints for communication, two relevant components might have a direct communication channel (without FIWARE). Please note that not using FIWARE needs to be well justified.

The applicants are encouraged to design how the communication among components in their proposal would be realised (e.g. via the Context Broker or other approaches).
The chosen implementation of containers is Docker. Software modules should be provided as Docker images and run as containers (unless an alternative approach is justified, as for instance for mobile applications).

Data architecture

Usage of the uniform SHOP4CF data models increases the composability and interoperability of the software components, making the SHOP4CF framework easily adaptable to new scenarios. Thus, whenever software components exchange information, it should be modeled using the SHOP4CF data models.
Figure *3* presents the top-level overview defining the basic data models for factory locations, tangible resources (equipment, materials, human workers, etc.), alerts (exceptional situations), and tasks under execution together with their definitions. Please note this overview does not include all SHOP4CF data models.

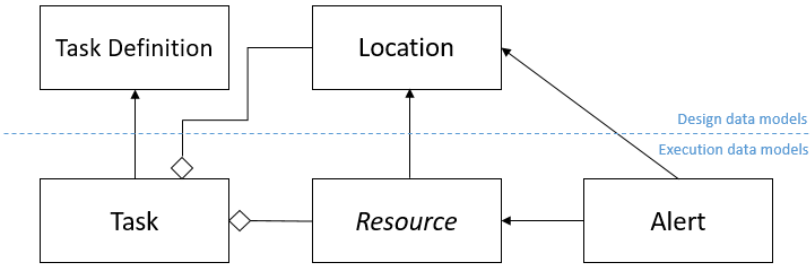

Figure 3: Top-level concept data models

In addition to those concept data models (definitions of entities and their interrelations), SHOP4CF defined example technical representation of some data entities in the FIWARE NGSI-LD format that is the adopted technical data format in SHOP4CF. The preliminary examples are available here.
The applicants are encouraged to identify which data models could represent the information to be communicated within their proposed systems.

5. Selection of Pre-Existing Components

As mentioned before, applicants are asked to integrate at least a single pre-existing component. Every pre-existing component is implemented on the basis of the architectural requirements of the previous section and is tested either in lab conditions or in a real use case. A full list of components can be found in the *Appendix A: Full List of Pre-Existing Components*. Moreover, a short video of the components can be found on the SHOP4CF website: https://shop4cf.eu/outcomes/

6. How to Adress Human Factors

The applicants are asked to address the effects on human work in the proposal. The pilot description should consider the following viewpoints: What is the main relevant human-related issue to be solved or improved, what kind of human-technology interaction the pilot case introduces, and which are the most relevant workers or worker groups that are affected by the pilot case implementation? The proposal may also include initial descriptions on possible new work tasks and/or changes in work tasks after pilot implementation, and what kind of new knowledge and competencies will possibly be needed.
The current SHOP4CF pilot use cases are expected to create impact on specific human aspects such as communication, problem-solving, decision-making, physical/mental workload, learning/guidance, task adaptivity and human error. These aspects can be utilized in the proposals but they are not exclusive; the applicants are also encouraged to propose human-related matters to be improved based on their own relevant production and industrial needs.
The SHOP4CF project provides a design and evaluation framework with the human-centred design approach. This framework guides solution development in a way that specified topics related to human factors are considered throughout the project from design to evaluation. The framework is emphasing the human workers' personal experiences and evaluations on the new solutions and focuses especially on user experience, user acceptance, usefulness, usability, ergonomics, safety and ethics. The chosen applicants will have access to the framework documents and related materials, such as questionnaires and guidance for user studies.

Please note that the consideration of effects on human work is a specific measure in the overall evaluation of applicants proposals (see Section 9 for more details).

7. Support & Monitoring

Two moderators from the core consortium will be assigned to each of the funded projects including regular consulting of the experiments, continuously evaluating the results, and immediately introducing corrective actions if needed.

Moreover, a range of supporting activities will be offered:

- **Technology training** to support the efficient deployment of pilots and development of the new components. This will include hands-on workshops focusing on deployment of the framework and the integration of new components as well as component-specific training (e.g., in form of webinars).
- **Business coaching** to provide guidance on how to best present/advertise the new components/pilots that is deployed on the SHOP4CF marketplace. Moreover, the individualized coaching will focus on supporting the companies in their expansion to new, previously unreachable markets.
- **Finance mentoring** to support the involved companies, especially the developers of new components, in acquiring follow-up funding and ensuring their long-term success. This will include the linking with corporates that may become the next big customers and thus the launch pads to further expansion.

The call will also reach out to a wider group of corporate users or solution providers with the interest to support and "sponsor" the expansion of the SHOP4CF innovation eco-system.

8. General Conditions

8.1 Entities eligible for funding

As mentioned before, applicants are asked to apply in teams consisting of two partners, one being an integrator (first partner) to implement the solution at the production side of the manufacturing company (second partner). Both partners need to be established at the time of the application. At least one of the partners needs to be an SME (definition can be found here). Note that partners of the SHOP4CF consortium cannot apply to the calls. The European Commission's (EC) eligibility and financial rules apply to all subprojects to be funded under this call and should be considered already at the proposal submission stage (details can be found here). In particular, the members of the applying teams must therefore be established in the EU Member States or Horizon 2020 Associated Countries (details can be found here). Successful applicants must possess a validated Participant Identification Code (PIC) (details can be found at EC web-page). However, at the moment of submission, the entity can apply by using a provisional PIC.

8.2 Funding

The total call budget is € 600K, and a maximum of six pilot projects will be selected. Each pilot project will last for eight months (1 November 2021 – 30 June 2022).

A lump sum of € 100K will be granted to each pilot project for covering the personnel expenses and costs of travel (including accommodation) and consumables. Durable hardware can be made available as an "in-kind" contribution by the partners or by large corporate sponsors that wish to contribute to the pilot. Other types of expenses are not eligible for funding. The maximum amount may not exceed €60K for each partner. For non-profit organizations, 100% of their eligible costs will be refunded; for-profit organizations will be funded at a rate of 70%. Each applicant can qualify for funding only once under the umbrella of the three Pilot Establishment open calls of SHOP4CF - multiple funding within three different Pilot Establishment calls is not possible. However, upon successful completion of the Pilot Establishment project, the manufacturing partner of the project will be able to submit a use case to the Pilot Extension call.

It is encouraged to include large corporate industries that support ("sponsor") the SME driven pilots with (in-kind) contributions e.g. through concrete technology (e.g., software components, robotics, augmented reality devices etc.), by making available test environments, interest in promoting the SHOP4CF digital market place and its components with their brand name, evaluating the impact of human-machine interaction of novel solutions or otherwise.

Successful applicants will receive 40% of the estimated costs as pre-payment. Further payments will be made upon successful completion of milestones and deliverables, as specified in the respective contract with the coordinator of SHOP4CF, available here. These accomplishments will be measured using Key Performance Indicators (KPIs) that are individually defined for each pilot project as a basis for the bi-monthly monitoring of the pilot experiment. The interim payment of 40% of the estimated costs will be made after the fourth month upon achievement of specific KPIs (please see subchapter 8.3). Thus, applicants can receive a maximum of 80% of the costs during the runtime of the project, while the final instalment will be paid at the end of the project, after evaluation by SHOP4CF consortium. Timeline of the first Open Call – *Pilot Establishment Instrument 1* is shown in Figure 4.

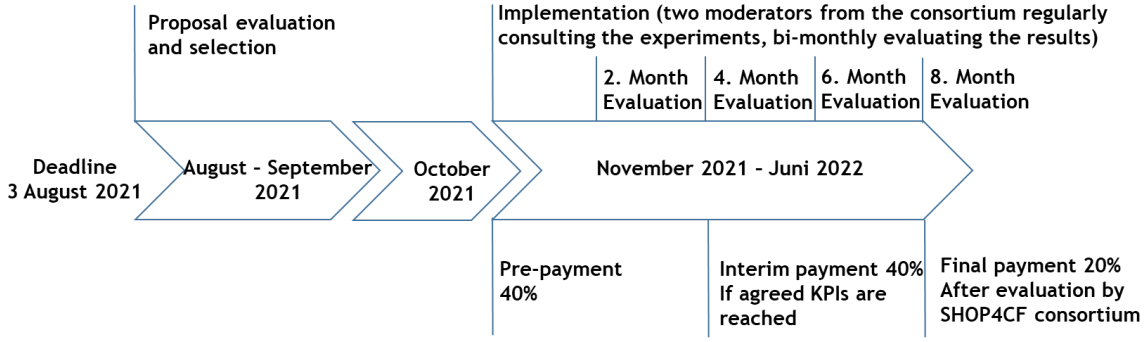

Figure 4: Timeline of the Pilot Establishment Instrument 1 call

8.3 Key Performance Indicators

All proposals are required to suggest a limited set of individual KPIs to track the progress of the project against plan and the progress in technology development or integration of the components in the pilot, respectively. Furthermore, it is required that applicants propose specific KPIs at the end of the fourth month in which the interim payment will be made. Relevance and appropriateness of proposed KPIs will be assessed during the evaluation of proposals by independent experts who will be asked to also evaluate the feasibility of the project in terms of time, scope and ambition. Final KPIs will be negotiated during contract preparation and may be subject to fine tuning.

9. Pre-proposal Submission

As a special service to potential applicants, pre-proposals can be submitted via the SHOP4CF open call platform during the first six weeks after publication of the call. It is worth noting that pre-proposals are optional for applicants. The respective template and the applicable deadlines are provided here. Within one week after the deadline for pre-proposal submission, the applicants will receive feedback on their pre-proposal. The feedback will be focused and limited on clarifying whether the proposal fits into the scope of the call. In addition, suggestions for improving the proposal, if any, will be made. Please note that the feedback to the pre-proposal will not have any impact on the assessment of the full-fledged proposal.

10. Proposal Submission

The proposal will be submitted via the SHOP4CF open call platform (link) where all supporting documentation will be available. The applicants are required to

- enter the proposal information and partner data,
- upload the proposal document as a PDF (the proposal template can be downloaded from SHOP4CF open call platform (link) and has to be strictly followed),
- enter the requested budget information,
- submit the complete proposal.

The applicants can edit their proposal before the deadline (e.g., submit revised versions); only the last version will be considered for evaluation. It is the responsibility of the applicants to ensure timely submission. Failure of timely submission of the proposal for any reason, including communication delays, will automatically lead to rejection of the proposal. The time of receipt of the submission, as recorded by the submission system, will be authoritative.

Shortly after the submission of the proposal, an acknowledgement of receipt will be sent to the email address of the proposal's primary contact person, registered on the platform. Sending an acknowledgement of receipt does not indicate that a proposal has been accepted as eligible for evaluation.

For any given proposal, the proposal primary contact person will act as the primary point of contact between the proposal partners and the SHOP4CF consortium.

Upon receipt by SHOP4CF, proposals will be registered, and their contents entered into a database to support the evaluation process. The proposals will be checked whether they fulfil the H2020 admissibility and eligibility criteria (link) in order to be retained for evaluation (see below).

A proposal is admissible if:

- it was submitted via the official online submission system before the call deadline;
- it is written in English;
- it is complete, i.e. all the requested fields within the application have been completed;
- it is readable, accessible and printable;
- it does not exceed the maximum number of pages indicated in the proposal template;
- all the administrative forms were filled, including the requested budget.

A proposal is eligible if:

- its contents are in line with the topic of the call;
- it is submitted by eligible proposers (details are given in subchapter 8.1 and meets any other eligibility conditions set out in the Call text or Guide for Applicants;
- the proposing Partner Organizations are established in EU Member States or Horizon 2020 associated countries (link);
- the proposing Partners have the operational capacity to carry out the activities related to the main objective of the call;
- it's project duration is in line with the timeframe defined in the call, 1 November 2021 – 30 June 2022.

In addition, the proposals have to strictly adhere to the template provided via the SHOP4CF open call platform, which defines sections and the overall length. Experts will be instructed to not consider extra material in the evaluation.

The SHOP4CF offers an email-based helpdesk system for applicants at info@opencalls.shop4cf.eu. Applicants are encouraged to use this facility for any queries concerning the call and the submission.

With the upload of the proposal template and the completion of the contact information, the applicants agree that partner(s) names, affiliations and proposal titles of the successful proposals (only) will be announced on the SHOP4CF website.

11. Proposal Evaluation

All submitted proposals, fulfilling admissibility and eligibility criteria, will be assigned remotely via the open calls platform to external evaluators, independent of the SHOP4CF consortium and without any conflict of interest with applicants. All evaluators will sign a declaration of confidentiality concerning the content of the proposals and the entire evaluation process. A declaration of absence of any conflicts of interest will be signed by evaluators as well. Each proposal will be evaluated by at least two assigned evaluators, with

different expertise in the relevant technology field or the application area(s) and business development. In the case of substantial deviation between the individual evaluations, a third independent evaluator will evaluate the proposal. The proposal evaluation process of proposals for the first Open Call in SHOP4CF - *Pilot Establishment Instrument 1* is shown in Figure 5.

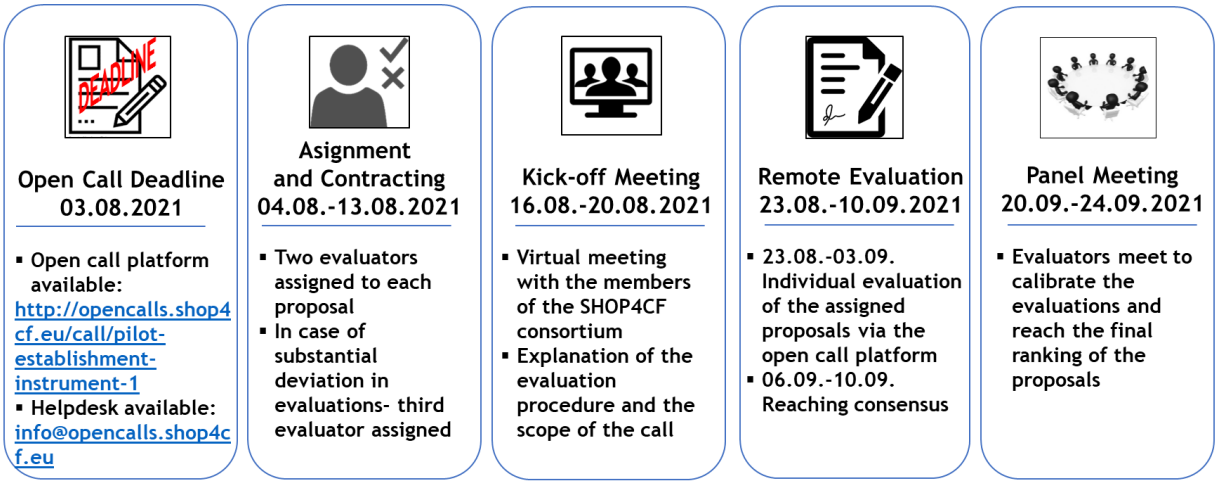

Figure 5: Proposal evaluation process for the Pilot Establishment Instrument 1 call

The proposal evaluation will be performed in two steps. In the first step, remotely via the open call platform, two evaluators will individually review each proposal according to the evaluation criteria (Table 2). The evaluators will score each criterion below and give explanatory comments. Scores for each evaluation criterion are in range 1 to 5 (details are given in Table 3). If an evaluator requires further clarification on any part of the application, SHOP4CF members will email the applicant requesting additional information with a deadline for response. After individual evaluations, the evaluators will discuss the proposal via a consensus blog available in the open call platform and explicitly agree on the scores and comments for the remote evaluation, reaching the consensus. The outcome of the first evaluation step is a so-called consensus report for each proposal and a ranked list of proposals. Those will be the base for the panel meeting that is the second phase of the evaluation. In the panel meeting, evaluators will discuss each application and agree on a final ranking. Within 30 days after the selection procedure, applicants will be informed whether their proposal was successful or not and receive the evaluation summary report. In addition, a public summary report will be published on the project website (link).

Applicants are asked to carefully review the evaluation criteria to directly address the aspects that will be evaluated by the reviewers.

Table 2: Proposal evaluation criteria

1. Technical Aspects	Reviewer comments	Score
Evaluate the **level of detail that the technical description** features. Please consider both the pilot description and the description of the new components. A high score implies that both parts are described in sufficient detail. *Please lower the score if the applicant did not answer this question in sufficient detail. Provide a brief comment on the score.*		__/5
Evaluate the balance between existing and new components. A high score indicates that 50% of the total functionality is covered by existing components and 50% by new components. Note that components can vary in terms of how much functionality they offer; hence, the sheer number of new/existing components alone might not be adequate to determine the score. Please lower the score if the applicant did not answer this question in sufficient detail. Provide a brief comment on the score.		__/5
Rate your **confidence that the described undertaking will be successful** in the given time frame and with the given funding. A high score reflects that the reviewer has no doubt that the desired project will be successful. *Please lower the score if the applicant did not answer this question in sufficient detail. Provide a brief comment on the score.*		__/5 (min. 3)
Do you expect **high-quality components** that have a good chance of being seamlessly reused as part of the SHOP4CF marketplace? A high score would indicate that the component is likely to be well implemented and can conveniently be reused/modified/extended. *Please lower the score if the applicant did not answer this question in sufficient detail. Provide a brief comment on the score.*		__/5 (min. 3)
Are the **available resources** in the form of experts and hardware appropriate for the execution of the planned project? *Please lower the score if the applicant did not answer this question in sufficient detail. Provide a brief comment on the score.*		__/5 (min. 3)
Are **human factors** sufficiently taken into account? Does the use case lead to an improvement of working conditions for the worker? E.g., the substitution of human labor should reduce this score tremendously. *Please lower the score if the applicant did not answer this question in sufficient detail. Provide a brief comment on the score.*		__/5 (min. 3)

Evaluate the described **Technical Readiness Level** (TRL) in terms of your confidence that the indicated level will be reached. E.g., if a TRL as low as 5 is not likely to be attained a score of "0" should be given. If a TRL of at least 7 (or above) that is likely to be attained is supposed to lead to "10". *Please lower the score if the applicant did not answer this question in sufficient detail. Provide a brief comment on the score.*		__/5 (min. 3)
2. Expected Impact		
Rate the **overall level of innovation**. A high score indicates a challenge that cannot be solved by conventional solutions and demonstrates the unique features of the SHOP4CF platform: Human factors, advanced methodologies, and the modular concept. *Please lower the score if the applicant did not answer this question in sufficient detail. Provide a brief comment on the score.*		__/5
Assess the **relevance of the components** to be developed. Are components envisioned that are sufficiently general to be reused? Are the components highly relevant for the community? A high score indicates a valuable addition to the SHOP4CF marketplace. *Please lower the score if the applicant did not answer this question in sufficient detail. Provide a brief comment on the score.*		__/5 (min. 3)
Are the **KPIs defined by the applicants appropriate**? Do the KPIs have a good balance between challenge and achievability? A high score would imply that the applicant does not set the KPIs neither too low nor too high. *Please lower the score if the applicant did not answer this question in sufficient detail. Provide a brief comment on the score.*		__/5 (min. 3)
Rate the **impact of the solution on the manufacturing industry**. A high score refers to a high probability that both the use case and the components have a good chance of attracting new companies to SHOP4CF. *Please lower the score if the applicant did not answer this question in sufficient detail. Provide a brief comment on the score.*		__/5 (min. 3)
Evaluate the potential for **commercial exploitation** of the use case as well as the components. A high score indicates a high degree of sustainability beyond this open call. *Please lower the score if the applicant did not answer this question in sufficient detail. Provide a brief comment on the score.*		__/5

3. Work Plan Description		
Is the **implementation clearly described** with a respective work plan and schedule? A high score means that the applicant was able to provide the complete picture of the planned project. *Please lower the score if the applicant did not answer this question in sufficient detail. Provide a brief comment on the score.*		__/5
Have the **risks been adequately taken into account**? Are measures defined to circumvent these risks? A high score would indicate that the reviewer is confident that potential risks have been minimized or eliminated. *Please lower the score if the applicant did not answer this question in sufficient detail. Provide a brief comment on the score.*		__/5 (min. 3)
Are the **milestones and deliverables defined by the applicants reasonable**? Do the KPIs show a good balance between ambition and feasibility? A high score would imply that the applicant is neither setting the KPIs too low nor too high. *Please lower the score if the applicant did not answer this question in sufficient detail. Provide a brief comment on the score.*		__/5 (min. 3)
Evaluate the respective **competencies of the partners**. Are the specific roles of the two partners clearly defined? Do the respective experiences of these partners cover most elements of the work plan? *Please lower the score if the applicant did not answer this question in sufficient detail. Provide a brief comment on the score.*		__/5 (min. 3)
Remarks		
Ethical implications and compliance with applicable international, EU and national law.		Essential

Scores		
	1. Technical Aspects Score:	___ /35 (min. 21)
	2. Expected Impact	___ /25 (min. 15)
	3. Work Plan Description	___ /20 (min. 12)
	Overall score:	___ /80 (min. 56)

Table 3: Proposal evaluation scores

0	Fails	The proposal fails to address the criterion or cannot be assessed due to missing or incomplete information.
1	Poor	The criterion is inadequately addressed, or there are serious inherent weaknesses.
2	Fair	The proposal broadly addresses the criterion, but there are significant weaknesses.
3	Good	The proposal addresses the criterion well, but **a number** of shortcomings are present.
4	Very good	The proposal addresses the criterion very well, but **a small number** of shortcomings are present.
5	Excellent	The proposal successfully addresses all relevant aspects of the criterion. Any shortcomings are minor.

12. Redress procedure

Upon receiving the evaluation results, the applicants have two weeks to start the redress procedure by sending a complaint via the proposal submission platform (link). The request for redress can only be related to the evaluation process, admissibility or eligibility checks. Please note that the Redress Committee will not call into question the judgements made by qualified expert evaluators, nor will it take into consideration any new information or explanations not included in the original proposal. All requests for redress will be treated confidentially. An internal Redress Committee will examine requests for redress and recommend an appropriate course of action to the SHOP4CF Consortium.

13. Ethical issues

Research activities in Horizon 2020, and particularly in SHOP4CF, should respect fundamental ethical principles, particularly those outlined in "The European Code of Conduct for Research Integrity" (link). Therefore, questions about ethical issues are to be addressed in the proposal text, if ethical issues apply to an application experiment, before and during the runtime of the research activities within SHOP4CF, including the approval by the relevant committees and the compliance with the recent General Data Protection Regulation (GDPR, link).

Appendix A: Full List of Pre-Existing Components

Abbreviation	**AR-CVI** (1): Augmented Reality for Collaborative Visual Inspection
Partner	Technical University of Munich (TUM)
Description	The AR-CVI component provides the ability to project visualizations in the work cell, for example, on a desk or wall. The visualizations can feature instructions, warnings, or notes that assist human workers in performing tasks such as the assembling of products. The visualizations can consist of simple shapes, text elements, or even complex documents. The visualizations are projected to a predetermined position by an ordinary projector that is mounted to the ceiling. The component is expected to lead to cleaner workplaces and reduce the cognitive load of human workers.
Communiation	The component requires a configuration file that contains a projector-specific projection matrix. This configuration file and the visuals (png or svg format) or written instructions (defined by a yaml file) are kept in a folder on the server that is mounted inside the Docker container. A start message and a slide identity (name of the yaml file defining the instructions) is sent via the FIWARE middleware to trigger the visuals. Afterwards, the component reads the instructions and projects them to the desktop as specified in the yaml file.
Deployment	Ordinary Projector that is attached to the ceiling of the workcell. Deployment in a Docker container whereas the visuals are mounted via the respective OS.

Abbreviation	**ROS2-Mon** (2): ROS2 Monitoring
Partner	Danish Technological Institute
Description	ROS2-Mon provides both static (publishers, subscribers, actions and services) and dynamic (configs, logs and status) information about ROS2 nodes in a graphical and easy to use format. For example, when one of the nodes dies, the component will notify the user about it as soon as the node is called. It's intended for monitoring ROS2 systems both in development and production.
Communiation	The component uses ROS2 infrastructure to detect other ROS nodes within the network. There is no need for complicated configuration.
Deployment	The component can be built as a standard ROS package, or deployed using Docker. ROS2 is required to use the component.

Abbreviation	**WPO-RL** (3): Workcell Process Optimization based on RL
Partner	Danish Technological Institute
Description	The component provides synchronous reinforcement learning logic wrapped in ROS2 packages. Its functionality was demonstrated on a problem of optimising throughput of a bin picking system. The component can be used for finding vibration patterns for separating items in the bin picking process, or by selecting a subset of dedicated nodes, used to build a new reinforcement learning based application.
Communiation	The component uses ROS2 infrastructure.
Deployment	The component can be built as a standard ROS package, or deployed using Docker. Two versions of the component will be available: "Application" or "Reinforcement Learning". "Reinforcement Learning" contains a subset of packages from the "Application" meant specifically to build new ROS2 systems, and natively doesn't have any hardware requirements. "Application" requires specific hardware in order to function: a manipulator, vibration feeder and smart camera. Both versions depend on ROS2.

Abbreviation	**DTS** (4): Dynamic Task Scheduling for Efficient Human Robot Collaboration
Partner	FZI Forschungszentrum Informatik (FZI)
Description	The component is a task manager for safe and efficient human-robot collaboration. It analyses the robot tasks and distributes them into sub-tasks, classifying them as: achievable or not, to be done or already completed. It also allows the robot to avoid collision with humans and objects in the surrounds by scanning the workspace with sensors (i.e. depth cameras) and using a volume based prediction, which allows the robot to update its current trajectory and goal if an unexpected object appears in the way.
Communication	The component is ROS(1) based
Deployment	Te component can be built as a standard ROS workspace or deployed using Docker. Minimal requirements: ROS(1) Framework kinetic or melodic, GPU-Voxels, depth cameras with fast update rate, 1 shuttle PC for robot control (with real time optimization), 1 additional PC with GPU for computational intense tasks, combination of several sensors (e.g. several cameras) is required for collision avoidance. Any robot with ROS driver, URDF description and real time joint angles is supported

Abbreviation	**FBAS-ML** (5): Force-Based Assembly Strategies for Difficult Snap-Fit Parts using Machine Learning
Partner	FZI Forschungszentrum Informatik
Description	The component is based on a generic add-on force-control for classical industrial and/or collaborative robots. An innovative force-sensor based strategy is used to fit two or more parts together that require a snap connection.
Communication	The component is ROS(1) based
Deployment	The component can be built as a standard ROS workspace or deployed using Docker. Minimal requirements: ROS(1) Framework with ROS control (kinetic or melodic), TensorFlow 2.1 with Python 2.7, 1 shuttle PC for robot control. Any robot with ROS driver and wrist force-torque sensor mounted (or integrated) is supported

Abbreviation	**F-TPT** (6): Flexible Task Programming Tool
Partner	FZI Forschungszentrum Informatik
Description	A graphical front end (GUI) to programm robotic applications by quickly creating control sequences based on ROS tools. The component helps to develop or change the collaborative robotic applications, gives monitoring feedback on the status of the procress and could be used to model different taks as well as the interaction between robot and human transparently.
Communication	The component is ROS based. It subscribes (and publishes) to ROS topics and services (from robots and external sensors). It requires a ROS bridge from topics and services to the GUI.
Deployment	The component can be built as a standard ROS workspace or deployed using Docker. Minimal requirements: ROS(1) Framework (kinetic or melodic)

Abbreviation	**ASA** (7): Automated Safety Approval
Partner	Fraunhofer IFF
Description	This component is for collaborative robotics applications featuring Speed and Separation Monitoring, and builds upon the SHOP4CF Safety Planning Tool. The Safety Planning Tool is a plug-in for the simulation software Visual Components and is used during the planning phase by designers to determine the size of the minimum required separation distance for robotic applications. It considers specifics of the application such as the robot, its program and speeds, tooling, workpieces, the environment, and the choice and placement of safety sensor, and it helps to determine the correct sensor placement and estimate the size of the minimum required separation distance. The component Automated Safety Approval is conceived to help when the robotics application is in operation and changes are planned. As an example, the robot speed could be increased to reduce the overall cycle time. The component receives an an input new robot trajectories (that are provided by a simulation software or other SHOP4CF component via FiWare), and it is designed to work without a visualization, only offering a pass/fail information regarding the planned safety measures. In case the safety configuration is no longer valid, the user needs to redesign the application with the Safety Planning Tool.
Communication	FIWARE
Deployment	as a docker container

Abbreviation	**RA** (8): Risk Analysis
Partner	Fraunhofer IFF
Description	This component supports the task of executing a risk analysis, which is required when designing a new robotic application or when changing/adapting an existing robotic application. It is explicitly tied to the safety of the robotic system. The risk analysis has the explicit steps of hazard identification and risk estimation. The review of the risk analysis is intended as support to a responsible human designer to help identify new hazards that result from system changes, and to highlight where the existing risk estimation requires updates. This functionality is to review an existing risk analysis and support the responsible human designer by identifying system changes that could result in new hazards (e.g. part changes including geometry and payload; robot changes including speed, reach, tooling; environmental changes including new tables, fencing, etc.). It is then the responsibility of the human to determine what new hazards arise due to the changes, and to also update the risk estimation and risk mitigation measures.
Communication	FIWARE
Deployment	as a docker container that starts a local web server

Abbreviation	**DYAMAND** (9)
Partner	imec
Description	DYAMAND enables users to connect, abstract, translate digital equipment and enables data to be used by applications in their required format. By using DYAMAND, devices from different vendors, using different communication technologies, can thus interact with eachother.
Communiation	In SHOP4CF, DYAMAND will translate inputs from heterogeneous systems, convert them to the SHOP4CF data format and push them on the FIWARE context broker so that the info can be used by other components (e.g. predictive maintenance on machine parts).
Deployment	Linux PC (e.g. Raspberry PI) with docker containers, connected to the backbone network of the factory.

Abbreviation	**FLINT** (10)
Partner	Interuniversity Microelectronics Centre (IMEC)
Description	The FLINT component can translate sensor inputs from heterogeneous IoT devices, databases or Cyber-Physical-Systems, translate them into the desired format and make them available for other components/systems. FLINT has built-in support for many wireless IoT standards.
Communiation	In SHOP4CF, FLINT will translate sensor/database inputs, convert them to the SHOP4CF data format and push them on the FIWARE context broker so that the info can be used by other components.
Deployment	Linux PC (e.g. Raspberry PI) with docker containers, connected to the backbone network of the factory. If connection is required to wireless sensors, the proper gateways will need to be installed (e.g. USB dongle to connect with ZigBee network, BLE module, ...). If database inputs have to be parsed, network connectivity is required to the database server. Protocol support is split up into docker containers.

Abbreviation	**OpenWIFI** (11)
Partner	Interuniversity Microelectronics Centre (IMEC)
Description	The OpenWIFI component provides low latency wireless connectivity on the SHOPfloor. OpenWIFI is transparant for connected devices: they should perform similarly as if they were connected over wired Ethernet. The implementation is open-source, allowing full customization of the WiFi standard based on the requirements of the use case. OpenWIFI is fully compliant with the 802.11 WiFi standard, so regular WiFi devices (smartphones, tablets, laptops, handheld devices) can connect to an OpenWIFI access point. When full control over the wireless link is required, both the access point and the client need to use the OpenWIFI hardware & software.
Communiation	Statistics of the wireless link will be exposed to the FIWARE context broker. In this way, the users of the wireless link (e.g. robotic arm) can receive a warning when the wireless link is unstable, or too slow. The robotic arm could then shut down to avoid potentially dangereous situations.
Deployment	Hardware (similar for AP and client): SDR board (e.g. from Xilinx) + Linux PC (e.g. Ubuntu 20.04). Linux PC will host a docker container to translate OpenWIFI statistics to the SHOP4CF data format and expose them on the FIWARE context broker.

Abbreviation	**Wi-POS** (12): Wireless Positioning system
Partner	Interuniversity Microelectronics Centre (IMEC)
Description	The Wi-POS component provides an accurate indoor localization system, based on Ultra-Wide-Band technology. The infrastructure requirements are very low, as the nodes communicate wirelessly using subGHz technology. The system can accurately track&trace e.g. AGVs or important assets on the SHOPfloor.
Communiation	Position information from the tracked units will be pushed to the FIWARE context broker in SHOP4CF data format, so the information can be used by other components.
Deployment	The system requires a minimum of 4 fixed anchor nodes, spread around the area where a mobile node (AGV, important asset) has to be tracked. The sensor nodes should be powered by an external battery pack or connected to a 5V power supply (e.g. USB). Hardware: Both anchor node and mobile tag require a dedicated sensor node. A docker container on a server (e.g. Raspberry PI running Linux) in the back-end will collect the position info and push to FIWARE.

Abbreviation	**HA-MRN** (13): Human Aware Mobile Robot Navigation in Large-Scale Dynamic Environments
Partner	IRT Jules Verne (JVERNE), FZI Forschungszentrum Informatik (FZI)
Description	Provides a Mobile Robot (AGV) the capability to detect humans near its path and to adapt the trajectory according to safety and social rules
Communiation	The component is ROS(1) based
Deployment	The component can be built as a standard ROS workspace or deployed using Docker. Minimal requirements: ROS(1) Framework (kinetic or melodic), external sensors (lasers, cameras), Open Pose. Any AGV with ROS driver is supported

Abbreviation	**IL-DT** (14): Digital Twin for Intralogistics
Partner	Poznan Supercomputing and Netorking Center (PSNC)
Description	The main goal of this component is to support engineers, intralogistics, and lean specialists to prepare data for the automatic or semi-automatic generation of an intralogistics simulation (digital-twin) model. The component generates such a model based on collected data: topographic data, data about operators (humans, robots, AGVs, AMR, AGLV), data about operations. After analysis and improvements in the simulation model, recommendations for changes in setting positions, timing, and routes are generated. The whole component is designed to meet the requirements of lean manufacturing principles.
Communiation	The component receives the dynamic intralogistics data (such as AGV movements) via FIWARE. The component also provides a user interface for semi-automatic collection of the static input data (such as the factory topography, source and destination points, etc.). The simulation model is visualized within a PC application. Output recommendations are provided in the form of a natural language report.
Deployment	The server-side module is run in Docker containers. The data-collecting user-interface application is run in a larger mobile device such as tablet. Executing the simulation model requires external simulation software LogABS (logabs.com) to be installed in a PC computer.

Abbreviation	**PMADAI** (15): Predictive Maintenance and Anomaly Detection in Automative Industry
Partner	Poznan Supercomputing and Networking Center (PSNC)
Description	The PMADAI component provides ability to detect problems occurring during the KTL painting process and to support maintenance needs in the KTL area of a paint shop. KTL stands for cataphoretic dip coating of car bodyworks. Identification of problems includes detection of anomalous operation of equipment used in the KTL painting process. When abnormal operation is detected component generates alerts for human workers. The component provides also detailed visualizations of the characteristics of the painting process. By providing all mentioned functionalities the component is expected to support human workers during their day-to-day tasks within the factory.
Communiation	The component requires a configuration file that contains settings for its modules, SQL database, and Influx database. All communication between the component and its working environment takes place through FIWARE. Once measurements and work status for a new painting process are obtained via the FIWARE middleware they are stored for further usage in component databases and detection of potential problems is performed. If some problems are detected in the measurements that describe the painting process alerts are triggered. Detailed visualization of recent painting processes is also provided. The visualization is interactive and shows current waveforms associated with the painting as well as contextual metadata needed to carefully assess the situation. Any deviations from normal behavior are highlighted.
Deployment	Hardware: server or servers allowing to run an SQL database, Influx database, and component modules. Deployment in Docker containers.

Abbreviation	**VQC** (16): Visual Quality Check
Responsible Partner	Poznan Supercomputing and Netorking Center (PSNC)
Description	The VQC component provides a set of tools for automated product quality check. The variety of tools from standard image processing methods to machine learning based approaches makes this component flexible enough to fit many problems, where quality is verified on visually, e.g. finding missing components or detecting defects on surface. This component is expected to automate quality verification process or to improve performance of existing systems.
Communiation	The component receives the images directly or gets directory to image(s) where it can read it, but is not able to trigger a camera. After analysis it returns the decision to system. The messages are sent via FIWARE middleware. The component works on a server, which is inside the Docker container.
Deployment	Deployment in a Docker container. Hardware: Some machine learning approaches may require GPU accelerator for better performance.

Abbreviation	**ADIN** (17): Adaptive Interfaces
Partner	Tampereen Korkeakoulusaatio SR (TAU)
Description	This component creates user interfaces depending on the information collected from the production line devices and the user's profile. By doing so, relevant task and operation specific user interfaces are composed for the user. Such interfaces could for example display task specific work description (e.g, description of assembly operation) to users and enable the user to confirm completion of tasks for interaction with external components. It should be noted that if applicable, other interfaces with different functionalities may be developed based on the requirements.
Communiation	Communication in FIWARE
Deployment	HW: N/A SW: Deployment in Docker container

Abbreviation	**DCF** (18): Data collection framework
Partner	Tampereen Korkeakoulusaatio SR (TAU)
Description	The Data Collection Framework (DCF) is a module that enables the data collection form the factory shop floor and Enterprise Resources Planning (ERP). Further, the DFC homogenizes and analyses process and data streams using a Complex Event Processing (CEP) engine.
Communiation	Communication in FIWARE
Deployment	HW: N/A SW: Deployment in Docker container

Abbreviation	**M2O2P** (19): Multi-modal offline and online programming solutions
Partner	Tampereen Korkeakoulusaatio SR (TAU)
Description	The main functionality of this component is to enable robot control using natural human actions as input, in this case hand gestures using a gesture tracking glove. With sensor glove by CaptoGlove LLC, the operator makes distinguishable hand gestures in order to command and control the robot in the process. The component is reconfigurable for different controlling scenarios.
Communiation	Sensor data is sent from local machine to Application Controller (deployed in Docker container) using TCP/IP connection. Sensor data is processed and transformed to gestures, commands and other forms if needed. Furthermore the connection to UI and FIWARE ROS2 plugin is established using ROS2 topics.
Deployment	Hardware: PC Software: Capto Suite (configuration software), CaptoGlove SDK (sensor reading and client software) and Docker running on host OS, which has to be Windows 10 (requirement for CaptoGlove). Application Controller and all other programs will be deployed in their own containers.

Abbreviation	**VR-RM-MT** (20): Virtual reality set for robot and machine monitoring and training
Partner	Tampereen Korkeakoulusaatio SR (TAU)
Description	The main functionality of this component is to enable the training and support of human workers in collaborative tasks. For doing so, the main activities of the collaborative task and the interaction of worker and robot is created in Virtual Reality (VR). By using a virtual reality headset and equipment the worker can remotely visualize, monitor and perform the training of collaborative tasks with robots. It should be noted that based on the use case requirements (e.g., workspace and environment, equipment, safety aspects and interfaces to other components), several data inputs might be needed for creation of custom simulations.
Communiation	Communication in FIWARE
Deployment	Hardware: VR-Headset As the technology is based on A-frame (web framework), the simulation can also be accessed in a web browser. External GPU for rendering the simulation SW: 3D images of workcell and equipment, coordinates in the workspace Deployment in Docker container

Abbreviation	**AR_Manual_Editor** (21): Augmented reality-based content editor - ARContent
Partner	Fundación Tecnalia Research & Innovation (Tecnalia)
Description	The AR-Manual Editor is composed by a web-based authoring tool and a visualizator. The authoring tool allows people to create a digital manual with AR functionalities, step by step, in an easy way and without programming languages, while supporting operators' training targeting the use and maintenance of products. The visualizator tool allows operators to download an AR manual, done with the authoring tool, in a mobile device or Hololens glasses to guide them in an activity or task in the shop floor step by step and with augmented reality.
Communiation	Integration will be done using Dockers.
Deployment	Mobile device with camera and/or Hololens

Abbreviation	**AR_Teleassistance** (22): Augmented reality-based content editor
Partner	Fundación Tecnalia Research & Innovation (Tecnalia)
Description	The AR-Teleassistance tool enables communication between workers and experts through video streaming and Augmented Reality (AR) indications supporting operators with the maintenance tasks and collaboration of working processes in real time. The operator calls the expert with the AR-Teleassistance tool in real time and the expert gives the operator the instructions to solve the problem or to perform the next step in the task with AR .
Communiation	Integration will be done using Dockers.
Deployment	Mobile device with camera and/or Hololens. ARCore library installed in the Android devices

Abbreviation	**MPMS** (23): Manufacturing Process Management System
Partner	Technical University of Eindhoven (TUe)
Description	MPMS includes the functionality to design end-to-end manufacturing processes and describe human and automated agents in the process (process modeler), and to execute in an automated way the processes by coordinating activities and assigning activities to agents (process engine). It provides orchestration of activities in a global level, i.e., covering all work cells/production lines of a factory, and vertically integrates the various technologies on the shop floor. MPMS supports: 1) dynamic agent allocation by selecting the best agents to perform a task for optimal utilization, 2) exception handling on agent, task and process level, and 3) process monitoring for a complete status overview of the manufacturing processes. The process models are specified in the BPMN language. The process models developed in the process modeler are purposed to facilitate the better understanding of the process and enable process analysis. Next, they are further enhanced in order to be executable by the MPMS process engine, and to be able to communicate with the other SHOP4CF components and actors.
Communication	During execution, the MPMS process engine executes the logical sequence of activities, as modeled in the BPMN process models. This typically involves sending task assignment messages (i.e., what has to be done and by whom) to the local components that control the robots or devices (i.e., MPMS, as a global component, does not interact directly with the robots but with the local components that control them). This communication is either direct (e.g. through REST calls), or, preferrably, through the FIWARE middleware. MPMS receives task status information (e.g. task_completed/task_failed) from the actors (through their local, control components), either by invoking MPMS's REST API or, preferrably, through FIWARE middleware. MPMS interacts with FIWARE middleware to retrieve information (e.g., alerts) that is useful in the execution of the process logic of the process models. Similarly, MPMS interacts with DBs to retrieve any information (e.g. list and definition of actors) which is used in the execution of the process logic of the process models. MPMS, can also interact with other enterprise information systems, e.g. ERP/MES, to get relevant information (e.g. production orders scheduling), preferrably through FIWARE.
Deployment	MPMS is built on top of Camunda BPM (https://camunda.com/), an open-source platform for process automation. The Camunda platform is a flexible, Java-based framework which can be deployed in different scenarios: (a) as a shared, container-managed process engine, which is started inside a runtime container (e.g. Servlet Container or Application Server) and is provided as a container service that can be shared by all applications deployed inside the container (b) as an embedded process engine, which is added as an application library to a custom application (c) as a standalone (remote) process engine server - in that case, the process engine is provided as a network service and different applications running on the network can interact with it through a remote communication channel. Docker images are also available. The MPMS application, as built for SHOP4CF project, is deployed as a Java application.

Abbreviation	WoT-IL (24): Interoperability Layer Through Web of Things
Responsible Partner	Universidad Politécnica de Madrid (UPM)
Description	The WoT-IL is a tool that will port any REST interface based on OpenAPI on the W3C Web of Things (WoT) standard order to extend the interoperability through standard approach. It is a vertical component that can be used at global and local level with the restriction that the functionality that want to be mapped is provided through web-based API and documented with OpenAPI. This component supports the process management improving the interoperability of the system. It addresses the ability of the system to be standard interoperable. Basically, the component makes WoT compatible with OpenAPI. In this way we can take advantage of the greater power that WoT has by allowing us to describe semantic contexts.
Communication	Within the SHOP4CF architecture, this component is defined as a system adapter and serves as a bridge between the Fiware Context Broker (CB) and other components, exposing the data in the Web of Things standard. Or conversely, take the data generated in a use case and expose it in the CB. This component also has a version that works independently and that can be used without interacting with the CB. In this way, an API documented with OpenAPI can be converted into a WoT Thing Description or vice versa.
Deployment	To deploy the converter independently it is possible to use Docker. To use the component as a system adapter, it is necessary to analyze each use case to define the requirements for its deployment.

Abbreviation	**VR_Creator** (25): Virtual Reality Creator
Partner	Fundación Tecnalia Research & Innovation (Tecnalia)
Description	VR-Creator is a web-based scene configurator tool for creating immersive experiences with 3D and 360 content, by using a simulated environment where a worker could virtually train online and learn. This component allows to define the different scenarios, the interactable objects and the referenced content (such as text, images, video, sounds).
Communication	Integration will be done using Dockers.
Deployment	VR glasses