# Project Deliverable 5.2

Implementation plan

Worker-Centric Workplaces in Smart Factories

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About this document

Executive Summary

This deliverable 5.2 "Implementation plan" is a result of the project "FACTS4WORKERS – Worker-Centric Workplaces in Smart Factories" of the European Union's Horizon 2020 research and innovation programme under the grant agreement No. 636778.

It provides an overview over the activities needed for the successful implementation and deployment of the FACTS4WORKERS solution:

- The **term implementation** in a wider sense refers as an umbrella term to the deployment and all accompanying activities like the determination or the technical requirements of the user training.

- The term **deployment** in a narrower sense focusses on the activities during the roll out of the software solution, beginning with setting up the hardware and ending with a running software. As the FACTS4WORKERS solution will be rolled out in several steps, the deployment will be undertaken several times, each time enhancing the system.

The deliverable starts with an overview over the activities performed as part of the implementation and deployment process. In a second step they are set into a temporal context, providing a generic template for the timeline. The deliverable finishes by stating the UC-specific implementation plans. As the UC-specific data is highly sensitive and in most cases a company secret, the publish part of the deliverable only contains the general approach of the implementation plan.

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The following persons have made a direct contribution to the document. Please note that many others have also supported our work and we thank them all sincerely.

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Dx.x.................... Deliverable x.x (x ... placeholder)

F4W.................... FACTS4WORKERS

IP .... Industrial partner

IT .... Information technology

P .... Phase

S............................ Step

TRL...................... Technology readiness level

UC........................ Use case

WP....................... Work package

1 Introduction

This deliverable provides an overview over the activities needed for the successful implementation and deployment of the FACTS4WORKERS solution. In this context the following project phases are covered or touched by this document.
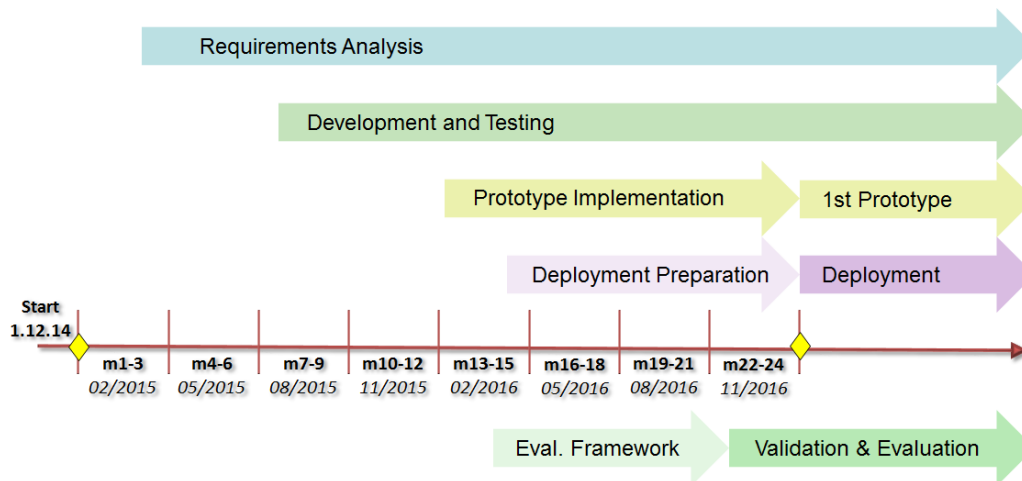
Figure 1: Project phases and time plan

- **Development and Testing** relate to the development of the building blocks and is one of the basic prerequisites for the deployment of a software solution. Following the agile approach of the project, the building blocks are continuously developed and released stepwise. This document states the efforts made to align the development of the building blocks to the resources of the partners. The development activities itself are not part of this deliverable as they are covered by *work package 2* (WP2) and *work package 3* (WP3). For further information, please refer to the *deliverables 2.5* (D2.5) and *3.1* (D3.1).

- The term **implementation** in a wider sense refers as an umbrella term to the deployment and all accompanying activities like the determination or the technical requirements of the user training.

- The term **deployment** in a narrower sense focusses on the activities during the roll out of the software solution, beginning with setting up the hardware and ending with a running software. As the FACTS4WORKERS solution will be rolled out in several steps, the deployment will be undertaken several times, each time enhancing the system.

- The expression **adaption** covers the customization of the already deployed building blocks based on the feedback of the users. Like *development and testing,* these activities are only touched by this deliverable as they are part of *work package 2* (WP2) and *work package 3* (WP3). For further information, please refer to the *deliverables 2.5* (D2.5) and *3.1* (D3.1).

- The expression long term **evaluation** refers to the assessment of the user experience and user satisfaction. As the workers need at least access to a running demonstrator for starting the evaluation, this phase begins after the first deployment. The evaluation itself also needs an extended preparation and planning which is part of *work package 6* (WP6) and is not included in this deliverable. For further information, please refer to the deliverables 6.2 (D6.2).

Chapter 2 starts with an overview over the activities performed as part of the implementation and deployment process. Especially for the preparation of the first deployment, a huge amount of information has been gathered. In this context, **appendix A** provides a generic overview over the most important information and requirements needed for the first deployment. Based on this summary, each UC-Leader built a IP-specific deployment plan (for the definition of the roles and responsibilities, please refer to *deliverable 5.1* (D5.1)). Since the data determined is highly sensitive and in most cases a company confidential, the public part of the deliverable only contains the general approach for the implementation plan. The sensitive information is stated in a not public accessible **appendix B**. If access to company data is needed and justified, please contact the project management of FACTS4WORKERS (*facts4workers@v2c2.at*).

Chapter 3 finishes the deliverable by setting the implementation and deployment activities into a temporal context, providing a generic template for the timeline. The UC-specific timelines can also be found in **appendix B.**

2 Implementation activities

The implementation process summarizes all activities needed for the successful deployment of the FACTS4WORKERS software solution. To increase transparency, all activities are divided into phases, steps and tasks.

- On the lowest level, **tasks** represent specific activities necessary for the successful deployment of the FACTS4WORKERS solution. To ensure a steady workload and prevent spikes, each tasks should be executable within a week (5 days / 40 hours).

- **Steps** summarize tasks belonging to the same subject area. Doing so, steps balance the needed efforts and provide a more stable measuring scale for the progress of the implementation process.

- **Phases** sum up the different steps into classes, providing a high level perspective.

The following figure shows a schema of phases, steps and tasks:
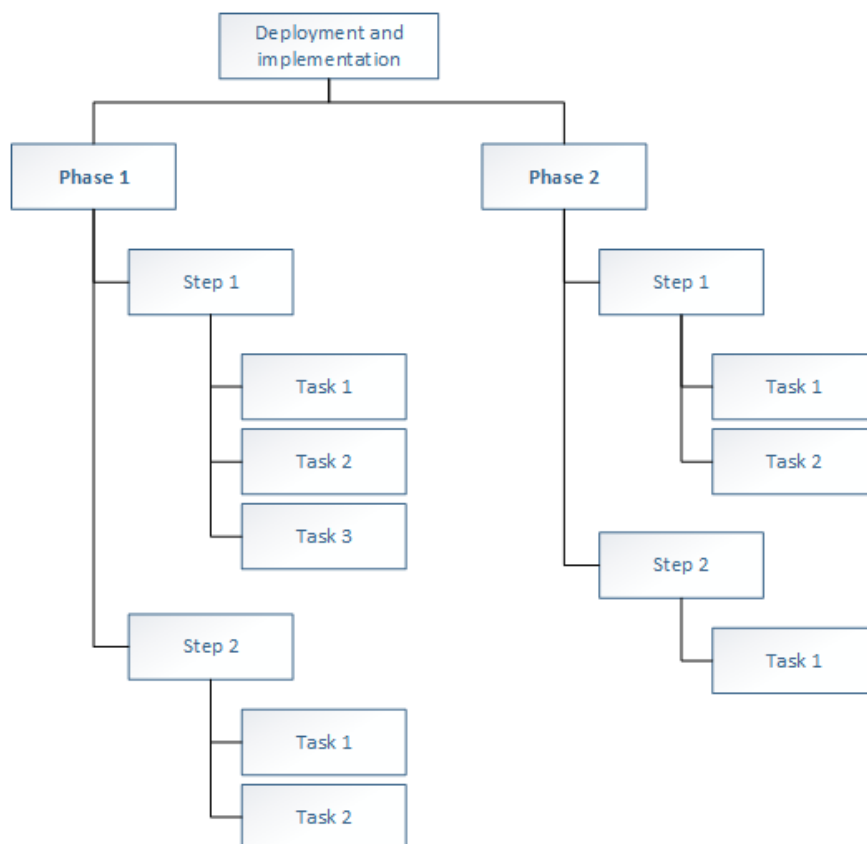
Figure 2: Schema Phases – Steps - Tasks

Following the agile approach of the project, deployment of the different solutions at industry partner sites will be performed stepwise. Thereby, the different deployment stages build the base for the separation of the tasks into phases:

1 **Deployment preparations:** Tasks performed in preparation of the first deployment

2 **First deployment:** Tasks performed during the first deployment

3 **Following deployments:** Tasks performed in preparation for and during the following deployments

The following figure shows a generic overview over the different deployment phases and steps.
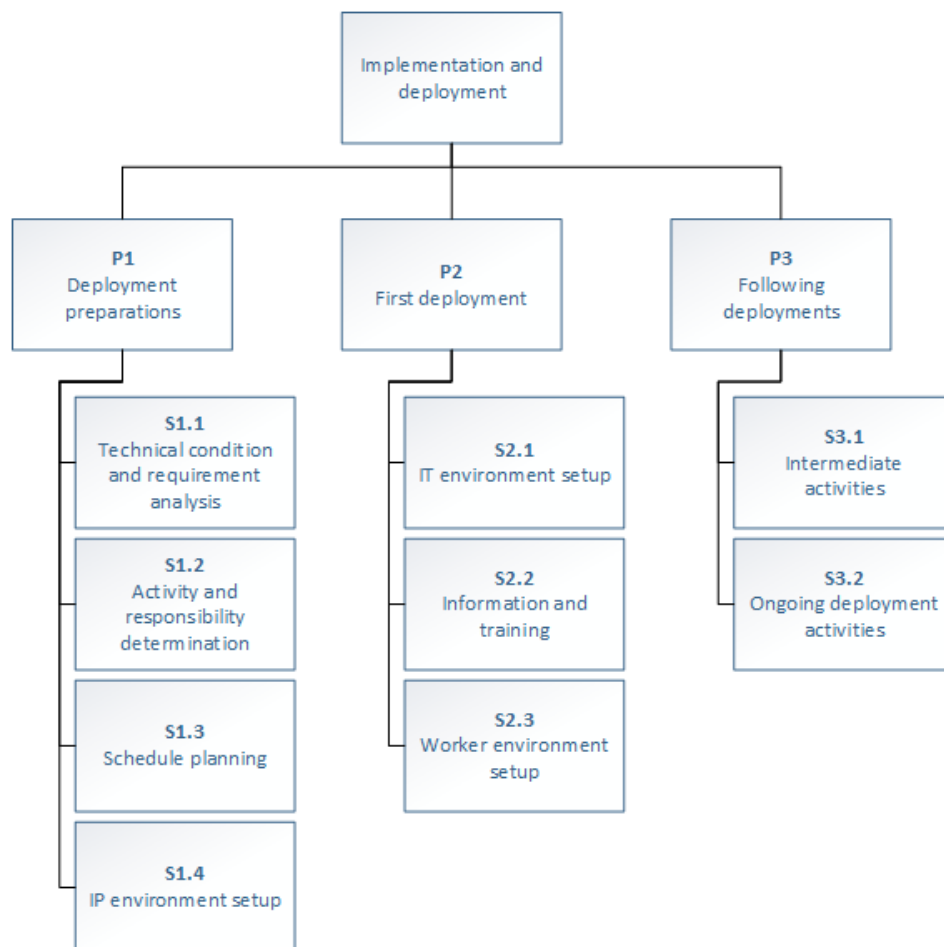
Figure 3: Overview Phases and Steps

Within the following sub-chapters, a general instruction for the implementation and deployment planning will be given. These chapters provide a generic approach of the tasks performed. For the UC-specific information please refer to **appendix B**.

2.1 Deployment preparation

Deployment preparation comprises all tasks performed preliminary to the first deployment.

2.1.1 Step 1.1: Technical condition and requirement analysis
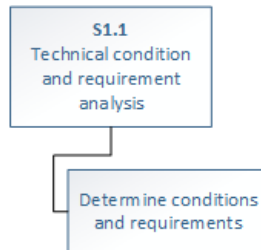
Figure 4: Step 1.1 - Technical conditions and requirements analysis

The **technical condition and requirement analysis** summarizes the activities needed for the assessment of

1. the current situation
2. the necessary requirements for the implementation of the FACTS4WORKES solution.

Although the topics are not limited to technical aspects, the term "technical" should emphasize the difference between these requirements and the ones gathered in *work package 1* (WP1). For further information regarding the worker-centric requirements please refer to *deliverable 1.2* (D1.2).

Determine conditions and requirements

In preparation for the first deployment, it was necessary to

- survey the context at IP site,

- determine the available infrastructure[1], hardware and software,

- determine the needed infrastructure, hardware and software,

- derive the gap,

- determine the needed personnel,

- determine UC-specific requirements and restrictions,

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[1] For the distinction between infrastructure and hardware see task *acquire and install infrastructure and hardware* of the step *IP environment setup*

♟ determine other UC-specific conditions.

Appendix A contains the summarization of all subjects surveyed in preparation for the implementation and deployment. Based on this summery, the IP-specific deployment plans were elaborated.

Appendix B contains the UC-specific data. For data protection and confidentiality reasons, this part will not be available to the public.

2.1.2 Step 1.2: Activity and responsibility determination
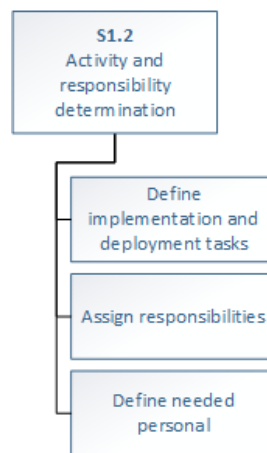
Figure 5: Step 1.2 - Deployment tasks and responsibilities determination

Based on the *technical condition and requirements analysis* the **activity and responsibility determination** deals with the definition and the assignment of the tasks necessary for the implementation and deployment.

Define tasks

In a first step the activities were defined. Due to the use of the perpetual beta approach, the main focus laid on the first deployment.

Assign responsibilities

Then, the responsibilities for the defined activities were assigned to the partners involved. The main distinction laid between responsibilities of the IPs and the ones of the scientific partners.

Define needed personal

Based on the responsibilities, every partner planed the personal needed for fulfilling the assigned tasks.

2.1.3   Step 1.3: Schedule planning
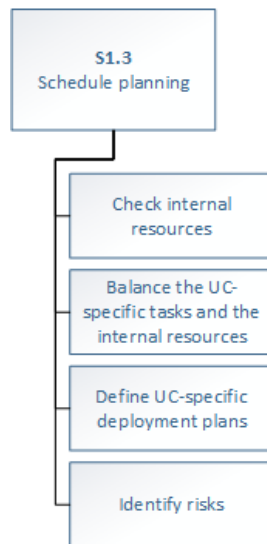
Figure 6: Step 1.3 - Schedule planning

With the technical conditions determined, the requirements determined, the implementation and deployment tasks defined and assigned, the UC-specific timeframes were planned.

Check internal resources

In a first step, the internal resources of all project partners were determined to ensure a feasible implementation and plan.

Balance the UC specific tasks and the internal resources

Based on the internal resources, the UC-specific tasks were balanced, to ensure a steady workload and prevent spikes. Additionally, the resources of the scientific partners were balanced to ensure a steady workload across the use cases.

Define UC-specific deployment plans

With the tasks balanced, the UC-specific implementation plans were defined.

Identify risks

In a last step, possible risks, measures to reduce these risks and reaction plans were defined.

2.1.4 Step 1.4: IP environment setup
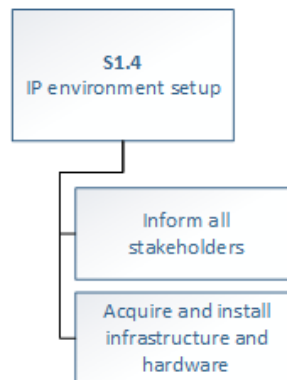
Figure 7: Step 1.4 - IP environment setup

The deployment preparations were finalized by setting up the environment at the IP.

Inform all stakeholders

Starting with informing all stakeholders, awareness for the upcoming deployment was created. Thereby it was important to include all persons who will be affected by the new system or have an interest in it, which includes, but is not limited to

- management
- end-users of the software
- project team at the IP site
- IT department at the IP site

Acquire and install infrastructure and hardware

For the preparation of the IP environment it was necessary to acquire and install the infrastructure and the hardware. In this context, the infrastructure includes the complete equipment where the installation calls for constructional interventions (e.g. WLAN router). Hardware on the other side includes all devices that can be used without these interventions (e.g. Tablet). For the description of the interaction between the different components, please refer to *deliverable 5.1* (D5.1).

2.2 First deployment

2.2.1 Step 2.1: IT environment setup
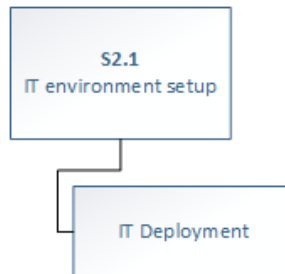
Figure 8: Step 2.1 - Software deployment

The first deployment starts with the software deployment.

IT Deployment

During the IT deployment, the following tasks have to be performed

- Install Docker (if not already done)
- Install the Containers
- Configure Nginx
- Configure the network
- Test API (Unit-tests)
- Test HMI (Unit-tests)
- Manual test the software on smart devices

For further information on the software architecture or the activities mentioned please refer to *deliverable 5.1* (D5.1).

After finishing these activities, the FACTS4WORKERS solution is ready to be used in the daily work routine. As in the first deployment a premature version of the solution is deployed, the system has to be further improved based on the feedback gathered. For further information to the approach used in the project, please refer to *deliverable 5.1* (D5.1).

2.2.2   Step 2.2: Information and training
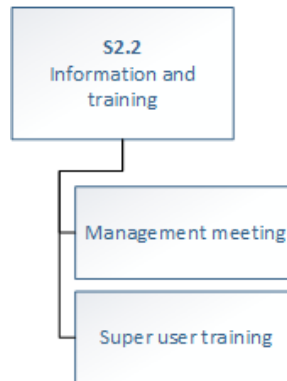
Figure 9: Step 2.2 - Information and training

The timely order of the tasks "management meeting" and "super user training" are interchangeable, depending on the preference of the IP. On one side, stakeholders could be informed first, which might help to reduce resistances against the project. On the other side, the super users could be trained first, allowing them to present the FACTS4WORKERS software solution to the stakeholders live in action.

Management meeting

Due to the worker centric approach of the project, implementation activities are focused on the needs of workers. Therefore, a separate management meeting is necessary as management is not that closely involved as in typical top down software projects. Within the management meeting, all stakeholders should be informed about the usage start of the FACTS4WORKERS solution. Besides creating awareness, this meeting should reduce resistances against the new system.

Super user training

At each company, one or several super users are selected, who will be trained first and more in detail. The goal is to have leading users, who are familiar with the new software system and will train the other users or will be able to answer their questions. Doing so, it is ensured that the knowledge is transferred smoothly. Additionally, this helps to empower workers as they get encouraged to interact with each other for knowledge sharing.

2.2.3 Step 2.3: Worker environment setup
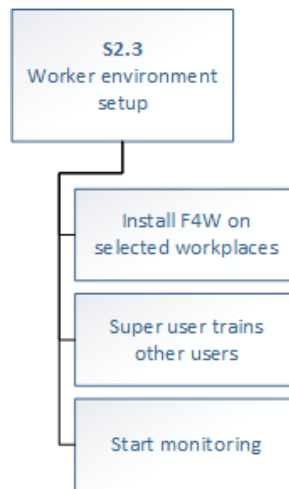
Figure 10: Step 2.3 - Worker environment setup

Install FACTS4WORKERS solution on selected workplaces

After the IT environment setup, the system has to be set up at selected workplaces. The objective is that the workers are able to use the system as support of their regular work.

Super user trains other users

Before using the system, the super users have to train the other users, so that they can fully make use of the new system. Additional, teaching material will be provided for super users, but because of the worker centric approach the project, all users should easily understand all functionalities, since due to the iterative evaluation activities, the users will already be familiar with the functionalities.

Start monitoring

After initial roll-out on first pilot workplaces, monitoring starts. This gives users the possibility to constantly provide feedback regarding the usability of the system. This way, the software can be adapted to the user needs, creating a system that benefits the workers at a high level. As monitoring will not be part of the implementation and deployment plan, please refer to *work package 6* (WP6) – **Evaluation** – for further information.

2.3 Following deployments

This phase contains all tasks performed in preparation for and during the following deployments. The *"intermediate activities"* and *"ongoing deployment activities"* are repeated alternating till the technology readiness level (TRL) is achieved, the software development is completed and the final system is deployed.

2.3.1 Step 3.1: Intermediate activities
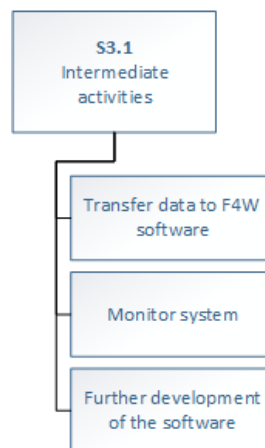
Figure 11: Step 3.1 - Intermediate activities

Intermediate activities include all tasks performed between deployment of two subsequent versions of the FACTS4WORKERS solution.

Transfer data to FACTS4WORKERS software

At the IP site, the data needed for the usage of the software system has to be entered. This could be done with different approaches, depending on the origin of the input:

- **Connectors** are linking existing databases to the FACTS4WORKERS solution. This could be an ERP system or other software systems. Hereby, the data will be transferred automatically.

- **Digital or hard copy data that cannot be transferred automatically**: This data has to be reworked manually before saving it in the FACTS4WORKERS database.

- **Worker knowledge**: This data is currently only available and needs to be entered manually. One key goal of the FACTS4WORKERS solution is to ease the sharing of this implicit knowledge.

Monitor system

During the usage of the system, the following activities have to be performed:

- Record software errors or malfunctions
- Gather feedback
- Evaluate worker satisfaction

As these activities will not be part of the implementation and deployment plan, please refer to *work package 3* (WP3) – **Adaption** – and *work package 6* (WP6) – **Evaluation** – for further information.

Further development of the software

Besides, the software solution has to be further developed and improved, including:

- Track and remove software errors
- Develop software improvements
- Add missing functionalities
- Improve TRL

As development activities are not part of the implementation and deployment plan, please refer to *work package 3* (WP3) – **Adaption** – for further information.

2.3.2   Step 3.2: Ongoing deployment activities
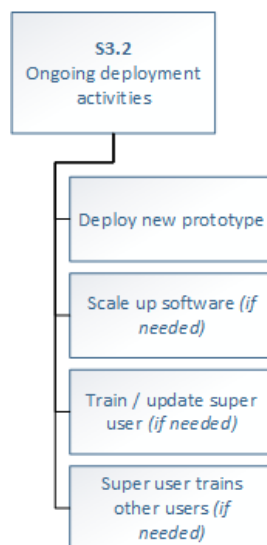
Figure 12: Step 3.2 – Ongoing deployment activities

The deployment activities include all tasks performed during the deployment of a new version of the FACTS4WORKERS solution.

Deploy new prototype

The deployment of the new prototype includes:

- Create back-up

- Replace updated Docker container (database should remain!)

- Test API (Unit-tests)

- HMI test (Unit-tests)

- Manual software test on smart devices

Scale up system

If additional workplaces get included in the pilot, it might be necessary to scale up the system. This includes:

- Deploy new or additional hardware *(if needed)*

- Scale up system if the hardware is no longer sufficient enough

- Manually test the software on smart devices

Train / update super user

If new functions get added, super users have to be trained.

Super user trains other users

Additionally, super users also have to train the other users.

3 Timeline

Like mentioned above, the implementation and deployment process consists out the three phases **deployment preparation**, **first deployment** and **following deployments**.
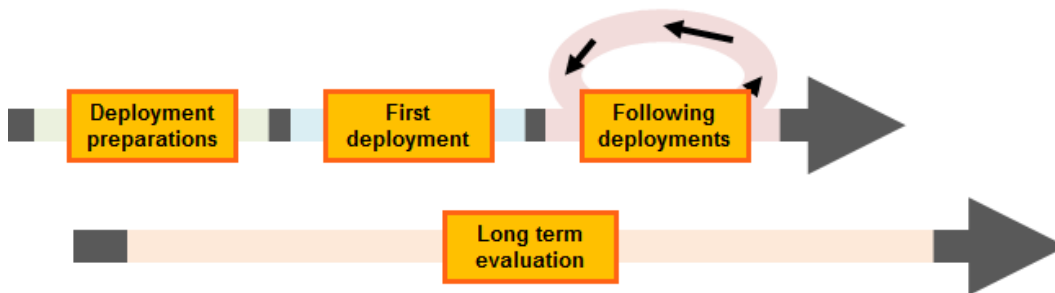
Figure 13: Deployment phases

While the agile approach of the project allows the simultaneous processing of activities of different phases, it is recommended to complete all activities of a prior phase before continuing with the next one. This ensures that dependencies between different tasks do not interfere with each other. In this context, quality gates assure that the basic tasks of one phase are performed before the implementation and deployment process continues. Besides, the container technology ensures that only approved versions getting deployed at the company side.

The **long term evaluation** refers to the tasks performed simultaneously to the system deployment as part of the impact evaluation. These activities will not be part of this deliverable, but are mentioned for the sake of completeness. For further information, please refer to *deliverable 6.1 (D6.1)* and *deliverable 6.2* (D6.2).

3.1 Deployment preparation

Step 1.1: Technical condition and requirement analysis

1. Determine requirements

Step 1.2: Activity and responsibility determination

2. Define tasks

3. Assign responsibilities

4. Define needed personal

Step 1.3: Schedule planning

5. Check internal resources
6. Balance the UC-specific tasks and the internal resources
7. Define UC-specific deployment plans
8. Identify risks

Step 1.4: IP environment setup

9. Inform all stakeholders
10. Acquire and install infrastructure and hardware

Quality gate 1: IP environment ready for first deployment

3.2 First deployment

Step 2.1: Software deployment

11. IT deployment

Step 2.2: Information and training

12. Management meeting
13. Super user training

Step 2.3: Worker environment setup

14. Install FACTS4WORKERS solution on selected workplaces
15. Super user trains other users
16. Start monitoring

Quality gate 2: First deployment successful (system can be operated without the direct supervision of a developer/UC responsible)

3.3 Following deployments

Step 3.1: Intermediate activities

17. Transfer data to F4W software
18. Monitor system
19. Further develop the software

Step 3.2: Deployment activities

20. Deploy new prototype
21. Scale up system

22. Train / update super user

23. Super user trains other users

Quality gate 3: TRL achieved (Continuous development/implementation ends when the TRL is achieved)

Appendix A: Technical Requirements

#	Task	Expected Outcome / Description
1	**WORKSPACE**	
1-A	**Determine workplaces involved in the FACTS4WORKERS software roll-out**	
	Description	Short description, identification of the workplaces
	Quantity	Number of workplaces involved in: 1) First implementation 2) Project overall
	Workplace specific environment	Description of the workplace environment *(e.g. Machines involved, light conditions, …)*
2	**INFRASTRUCTURE**	
2-A	**Determine existing infrastructure**	
	Connection	
	Type of connection	*e.g. LAN, WLAN, Telephone network: Edge, 3G, LTE*
	Availability	Availability on the workplace / work area
	Signal strength	*e.g. sufficient / not sufficient*
	Power supply	
	Location / accessibility	Location of existing, not used power supplies
	Type	Type of power supply *(e.g. 220V, Car 12V, USB, …)*
	Quantity	Number of not used power supplies

	Fixed mounting	
	Location / accessibility	Location of existing mounting possibilities for the devices
	Type	Type of mounting
	Quantity	Number of not used mounting possibilities
	Storage	
	Location	Location of existing storage facilities for the devices
	Type	Type of storage
	Quantity	Number of not used storage facilities
2-B	**Determine needed infrastructure**	
	Connection	
	Type of connection	*e.g. LAN, WLAN, Telephone network*
	Power Supply	
	Type	Type of needed power supply
	Quantity	Number of needed power supplies
	Fixed mounting	
	Type	Type of needed mounting
	Quantity	Number of needed mounting possibilities
	Storage	
	Type	Type of needed storage facilities
	Quantity	Number of needed storage facilities
2-C	**Determine quantity** *(needed infrastructure that has to be purchased/installed)*	
	Deviation between is and should	Quantity of needed infrastructure

2-D	**Procurement process**	
	Purchase	Acquire infrastructure
3	**HARDWARE**	
3-A	**Determine existing hardware**	
	Server	
	Type	*e.g. virtual / dedicated*
	Specification	*e.g. RAM, processor, …*
	Smart device	
	Type	*e.g. work station, notebook, tablet, smart phone, glasses, smart watch*
	Quantity	Number of smart devices
	Accessories	
	Type	*e.g. data entry assistance, protective cover, …*
	Quantity	Number of accessories
3-B	**Determine needed hardware**	
	Server	
	Type	*e.g. virtual / dedicated*
	Specification	*e.g. RAM, processor, …*
	Smart device	
	Type	*e.g. work station, notebook, tablet, smart phone, glasses, smart watch*
	Property	*e.g. display size, connectivity*
	Quantity	Number of smart devices

		Accessories	
		Type	*e.g. data entry assistance, protective cover, …*
		Quantity	Number of accessories
3-C	**Determine quantity *(needed hardware that has to be purchased/installed)***		
		Deviation between is and should	Quantity of needed hardware
3-D	**Procurement process**		
		Purchase responsibility	Responsibility of hardware purchasing
		Cost coverage	Responsibility of cost coverage
		Purchase	Acquire hardware
4	**SOFTWARE**		
4-A	**Define necessary prerequisites - Docker**		
		Minimal version	Minimal version
		Installation setting	Installation settings
4-B	**Define necessary prerequisites - Nginx**		
		Minimal version	Minimal version
		Configuration	Configuration
4-C	**Define necessary prerequisites - Smart Devices**		
		OS	Operating system; *e.g. Andriod*
		OS minimal version	Minimal version of the browsers
		Browser	List of browsers the FACTS4WORKERS solution works on; *e.g. Chrome, Mozilla Firefox*
		Browser minimal version	Minimal version of the browsers

4-D	UC specific (purchased) software	
	Type	Type *(e.g. Chat, …)*
	Licensing	Type of licensing
	Purchase responsibility	Responsibility of software purchasing
	Cost coverage	Responsibility of cost coverage
	Purchase	Acquire software
5	**BUILDING BLOCKS**	
5-A	**Determine company-specific BB**	
	Front-end BB	BB list
	Back-end BB	BB list
5-B	**Determine minimal BB for first deployment**	
	Front-end BB	BB list
	Back-end BB	BB list
	SWE	Configuration for first implementation
6	**CONNECTORS**	
6-A	**Determine IT systems/software that interacts / interferes with the FACTS4WORKERS solution**	
	Name	Name
	Description	Short description
	Planned interaction or interference	Planned interaction or interference
6-B	**Determine exchanged data**	
	Data	Description
	Type	Datatype

	IT system/ software	Name of the software which holds the data
	GET / POST	Allowed operations: Create / Read / Update / Delete
	Access right	List of people who should/could have access to this data
6-C	**Define needed (company specific) CON**	
	Description	Short description of functionality
	Accessibility	*e.g. HTTP, socket, middleware*
6-D	**Determine dependencies between the BB and the CON**	
	Affected BB	BB list
7	**SECURITY**	
7-A	**Determine security needs**	
	Security needs list	List of company specific security needs
	SSL certificate	Provider of SSL certificate
7-B	**Privacy / data protection**	
	Privacy requirement	List of company specific privacy regimentation
8	**ISSUE MANAGEMENT**	
8-A	**Determine bug report procedure**	
	Bug finding / reporting	Company specific bug report (if different from general FACTS4WORKERS procedure)
8-B	**Determine reaction plan**	
	Reaction plan	Agreed procedure for dealing with bugs (if different from general FACTS4WORKERS procedure)
9	**UC SPECIFIC REQUIREMENTS AND RESTRICTIONS**	
9-A	**Determine UC specific requirements**	
	UC specific requirements	List of UC-specific requirements *(e.g. barcodes for unit identification at TKSE)*

9-B	**Determine UC specific restrictions**	
	UC specific restriction	List of UC-specific restrictions
10	**PERSONNEL**	
10-A	**Determine in the deployment involved personnel**	
	Affected group	*e.g. IT department, FACTS4WORKERS responsible (at IP), power user, management*
10-B	**Author personnel list**	
	Name	Name
	Availability	Availability
	Individual skill	Individual skills
	Contact detail	Contact details
10-C	**Determine needed knowledge**	
	Software tool	List of needed knowledge regarding software tools for each personnel group
	Needed skillset	List of needed skills for each software tool
10-D	**Determine actual knowledge**	
	Software tool	List of needed knowledge regarding software tools for each personnel group
	Actual skillset	List of actual skills for each software tool
10-E	**Determine needed training to achieve knowledge**	
	Deviation between is and should	Needed training
10-F	**Determine form of training** *(e.g. seminar, web-seminar eBooks, …)*	
	Form of training	Training strategy for each personnel group

| 10-G	Determine stakeholders	
	Stakeholder	List of stakeholders; *e.g. management, other departments*
	Stakeholder information strategy	Strategy to keep stakeholders informed and reduce resistance

ABOUT THE PROJECT

The high ambition of the project FACTS4WORKERS is to create Factories of the Future with a pervasive, networked information and communication technology that collects processes and presents large amounts of data. These smart factories will autonomously keep track of inventory, machine parameters, product quality and workforce activities. But at the same time, the worker will play the central role within the future form of production. The ambition of the project is to create »FACTories for WORKERS« (FACTS4WORKERS), to strengthen human workforce on all levels from shop floor to management since it is the most skilled, flexible, sophisticated and productive asset of any production system and this way ensure a long-term competitiveness of manufacturing industry. Therefore, a serious effort will be put into integrating already available IT enablers into a seamless and flexible Smart Factory infrastructure based on work-centric and data-driven technology building blocks.

These solutions will be developed according to the following four industrial challenges, which are generalizable to manufacturing in general:

• Personalized augmented operator,

• Worked-centric rich-media knowledge sharing management,

• Self-learning manufacturing workplaces,

• In-situ mobile learning in the production.

PROJECT PARTNERS

The FACTS4WORKERS project is composed of 15 partners from 8 different European countries:

Virtual Vehicle Research Center	Austria
Hidria TC Tehnološki center d.o.o.	Slovenia
Universita degli Studi di Firenze, Department of industrial Engineering	Italy
Technische Universität Wien	Austria
ThyssenKrupp Steel Europe AG	Germany
Hidria Rotomatika d.o.o., Industrija Rotacijskih Sistemov	Slovenia
iMinds VZW	Belgium
Sieva d.o.o.	Slovenia
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Implementation plan

This deliverable 5.2 "Implementation plan" provides an overview over the activities needed for the successful implementation and deployment of the FACTS4WORKERS solution.

- The **implementation** refers as an umbrella term to the deployment and all accompanying activities like the determination or the technical requirements of the user training.

- The **deployment** is limited to the activities during the roll out of the software solution, beginning with setting up the hardware and ending with a running software. As the FACTS4WORKERS solution will be rolled out in several steps, the deployment will be undertaken several times, each time enhancing the system.

The deliverable starts with an overview over the activities performed as part of the implementation and deployment process. In a second step they are set into a temporal context, providing a generic template for the timeline. The deliverable finishes by stating the UC- specific implementation plans.

As the UC-specific data is highly sensitive and in most cases a company secret, the publish part of the deliverable only contains the general approach of the implementation plan.