vf-OS: virtual factory Operating System

WP1: Vision, Scenarios, and Requirements

D1.4b: Existing SOTA Analysis (M18) - Vs: 1.0.1

Deliverable Lead and Editor: Victor Fons, UPV

Contributing Partners: All

Date: 2018-03

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Status : Consortium Approved ~~¦ EU Approved~~

Short Abstract

This report acts as a 'coversheet' for the D1.4 SOTA Analysis M18 version which is delivered as the vf-OS Wiki (including a vf-OS glossary) at http://www.vf-os.eu/wiki. This wiki is of type 'OTHER' but for administration purposes this brief overview document is provided. The purpose of this Wiki/Task is to allow the partners a comprehensive and up-to-date investigation of existing state-of-the-art architectures, technologies, and solutions supporting collaboration in manufacturing and logistics among the supply chain and thus the concepts of vf-OS.

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History

See Annex B.

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This deliverable is subject to final acceptance by the European Commission.

Further Information

www.vf-OS.eu

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Project Partners:

ICE Information Catalyst

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Executive Summary

This report acts as a ‘coversheet’ for the D1.4b SOTA Analysis which is delivered as the vf-OS Wiki (including a vf-OS glossary) at http://www.vf-os.eu/wiki. This wiki is of type ‘OTHER’ therefore this brief overview document is provided for administration purposes. The purpose of this Wiki/Task is to allow the partners a comprehensive and up-to-date investigation of existing state-of-the-art architectures, technologies, and solutions supporting collaboration in manufacturing and logistics among the supply chain and thus the concepts of vf-OS.

Specifically, D1.4b **updates** on the results that were generated on D1.4a that concluded with relevant existing solutions that could be considered when developing vf-OS components. All the technical WPs, ie WP3 to WP7, have started and have gone through a process of designing the first versions of architectures of the different components composing vf-OS, identified in D2.1. Wiki explains a narrower analysis and selection of architectures.

Table of Contents

0 Introduction

0.1. vf-OS Project Overview

vf-OS – virtual factory Open Operating System – is a project funded by the H2020 Framework Programme of the European Commission under Grant Agreement 723710 and conducted in the period October 2016 until August 2019. It engages 14 partners (Users, Technology Providers, Consultants and Research Institutes) from 7 countries with a total budget of circa 7.5M€. Further information can be found at www.vf-OS.eu.

0.2. Deliverable Purpose and Scope

The purpose of this document "D1.4b Existing SOTA Analysis (M18)" is to act as a 'coversheet' for the D1.4 SOTA Analysis (including the vf-OS Glossary) which is delivered as the vf-OS Wiki at http://www.vf-os.eu/wiki. This wiki is of type 'OTHER' therefore this brief overview document is provided for administration purposes.

As with D1.4a, this document does not follow the standard and comprehensive reporting layout but is a light pointer to the Wiki with some brief background narrative. It is NOT the intent to replicate the Wiki on paper.

The purpose of the Wiki and the overall task is to allow the partners, primarily the technology providers, the opportunity for a comprehensive and up-to-date investigation of existing state-of-the-art architectures, technologies, and solutions supporting collaboration in manufacturing and logistics among the supply chain and thus the concepts of vf-OS.

Specifically, D1.4b updates on the results that were generated on D1.4a that concluded with relevant existing solutions that could be considered when developing vf-OS components. All the technical WPs, ie WP3 to WP7, have started and have gone through a process of designing the first versions of architectures of the different components composing vf-OS, identified in D2.1. The Wiki explains a narrower analysis and selection of architectures.

The changes to this living series of deliverables is identified in Section 4 of this document.

0.3. Target Audience

The document itself aims primarily at the EU for traceability of the outcomes of type OTHER. The Wiki is public and is relevant to all those working on the project and in the domain such as other RTD projects or organisations which would like to be updated on the vf-OS domains and concepts.

0.4. Deliverable Context

This document is overarching across most if not all vf-OS deliverables but especially influencing and receiving influence from those of WP2 (Architecture) and WP3-7 (RTD).

0.5. Document Structure

This deliverable is broken down into the following sections:

- **Section 1**: **Vf-OS Wiki Overview**: An introduction to the Wiki and this document

- **Section 2**: **Wiki M6 conclusions**: Overview of previous Wiki results
- **Section 3: Wiki M18 Evolution and Conclusions:** Overview M18 work done
- **Section Error! Reference source not found.**: **Version Changes:** Summary updates made in the Wiki
- **Section 5: Conclusions** to the document and next considerations

0.6. Document Status

This document is listed in the Description of Action as “public” since it represents non-confidential material which is of primary use for the project but may be of use to others as well.

0.7. Document Dependencies

This document is one of a series of three deliverables (D1.4abc) for delivery in the project at M6, M18 and M30. It updates the D1.4a deliverable primarily based on improvements in D2.1 following the review and initial work on WP3-7 initial design and development work.

0.8. Glossary and Abbreviations

A definition of common terms related to vf-OS, as well as a list of abbreviations, is available in the supplementary and separate document “vf-OS Glossary and Abbreviations”.

Further information can be found at http://www.vf-OS.eu/glossary.

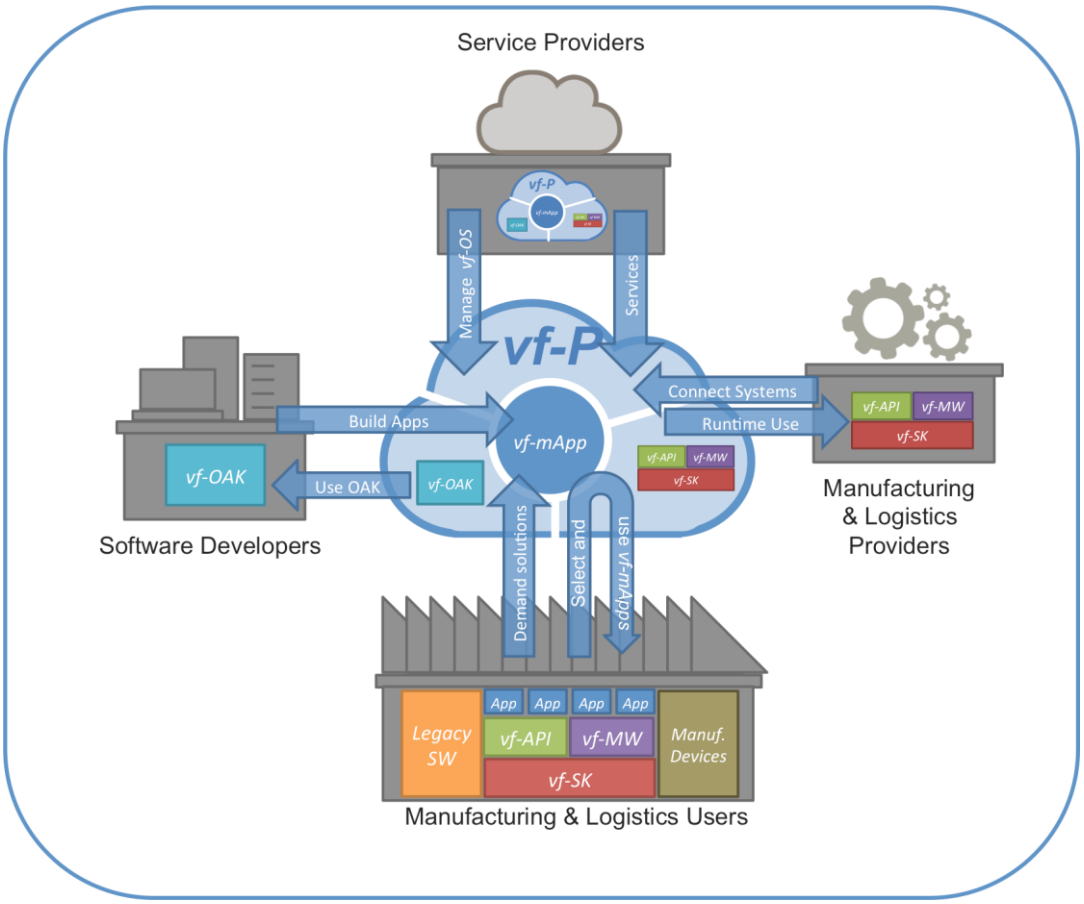
0.9. External Annexes and Supporting Documents

None

0.10. Reading Notes

None

1 Vf-OS Wiki Overview



The goal of vf-OS is to develop an Open Operating System for Virtual Factories composed of a kernel, application programming interface, and middleware specifically designed for the factory of the future. An Open Applications Development Kit (OAK) is also provided to software developers for deploying Manufacturing Smart Applications for industrial users, using the vf-OS Manufacturing Applications Store all operated through a Virtual Factory Platform. The figure above shows the 'big-picture' of vf-OS.

The vf-OS Wiki describes existing solutions giving ground to vf-OS technology solutions. The Wiki identifies standards, commercial solutions and Open Source solutions that could have an impact on the vf-OS solutions. These solutions are grouped together in various categorisations.

The vf-OS main solutions/components that set the boundaries covered by this Wiki are:

Term	Definition
vf-IO	IO Toolkit is a set of modules that virtualise factory's real assets and connect them to their virtualised images in the vf-OS. vf-IO implements Plug-and-Play mechanisms and device drivers for seamless/open access and smart virtualisation of the factory resources; it is composed of devices drivers, API Connectors, Security and Data Access. Thus, the vf-IO is composed of the modules that enable connectivity to assets like legacy ERPs, CRMs, CPSs, smart objects or wireless sensor networks.

vf-SK	Virtual Factory System Kernel is the core of the operating system, responsible for providing key system wide vf-OS resources and providing a set of specific services, which will be open and accessible; it is a specific set of libraries and infrastructure for vApps to be built upon and interact with each other; it is composed of a Framework, Generic Enablers and Manufacturing Enablers.
vf-MW	Virtual Factory Middleware is a set of modules for integrating data from arbitrary sources, ie vf-IO modules. The vf-MW provides a data infrastructure, data storage, data harmonisation, and data analytics features. The use of Cloud-based data storage avoids vendor lock-in issues and minimises the risk of system failures. Consideration will also be given if a particular Cloud-based data storage is no longer available. Accessibility of data will be facilitated through connectors and wrappers.
vf-Store	Virtual Factory Manufacturing Application Store offers fundamental services of a modern eCommerce platform for consumers and developers. First, vf-Store enables software developers to offer assets (demanded or initiative), and second, users are able to search for, obtain, and rate existing vApps. Furthermore the vf-Store acts as a mediator between developers and users. Therefore, the vf-Store is the central point for developers to get in contact with users. In addition to view/set ratings, reviews, and technical information about the asset's behaviour, the vf-Store supports users to get in contact with developers to offer ideas for new assets.
vf-App	Virtual Factory Manufacturing Smart Application is a vf-OS application, which aims to enable and optimise communication and collaboration among supply networks, but also within the organisation, of all manufacturing sectors in all the stages of manufacturing and logistic processes: demand forecast, planning, supply, manufacturing, distribution, storage, replacement, and recycling.
vf-OAK	Open Applications Development Kit is composed of a SDK to develop applications, a System Dashboard, the OAK Frontend Environment, the OAK Development Studio and a Developer Engagement Hub to engage developers. The SDK implements all the necessary APIs needed to develop vf-OS Assets. The OAK System Dashboard represents core software services for allowing system monitoring and configuration; the OAK Frontend Environment provides a framework that facilitates a general 'look, feel, and composition' to vf-OS Assets and will assist rapid development, by providing a compilation of UI elements including business logic to the OAK Studio; the vf-OS Development Studio is a desktop development environment that facilitates Technology Providers to compose their applications for running on vf-OS. Additionally, the Developer Engagement Hub is a collaboration platform for the vf-OS community to support each other.
vf-P	Virtual Factory Platform is a holistic service platform, which is the foundation for all services and end user applications that vf-OS will provide. vf-P encapsulates and acts as the interface between the components, connectors, OAK functions, marketplace, the service framework and the end user applications/developers. The vf-P is able to run locally and in Cloud environments.

The Wiki is composed of two main areas: The Wiki and the Glossary that were introduced in D1.4 (and that will be summarized in section 2) which are described in the following

sections along with a summary of the technology findings. In the annex is a short how-to guide used by the project partners. The wiki is based on a popular open source tool called 'Mediawiki' and is hosted by UPV. There is a navigation tree at the right of the page and also a search box at the top of the page that can be used to find and navigate to the defined knowledge areas.

vf-OS has also found mutual cooperation with the FOF projects CREMA and C2NET (due to an overlap of partners) where content has been embedded in the vf-OS wiki which both assists vf-OS (due to commonalities) and enables the SOTA work of these projects to 'live-on' after their termination in 2017-12. The "living-on" of the vf-OS wiki will also be determined at a later stage in the life of vf-OS.

Cooperation with the Connected Factory CSA was also initiated and explored by vf-OS but due to project timings and scope it proved not to be possible. However, the channels are open and vf-OS is open to sharing/linking/merging content in either direction.

This document is one of a series of three deliverables (D1.4abc) for delivery in the project at M6, M18 and M30. However, it is noted that the vast majority of the Wiki work, circa 80-90%, will have been undertaken in the initial 6 month period (for reporting in D1.4a). Further major updates of the Wiki will be recorded in this living document in Section 4.

2 Wiki M6 Conclusions

The main conclusions of Wiki at month 6 were the analysis of existing solutions and their presentation according to topics and entries. Topics were browsable through a navigation menu that provided categories (see Figure 1) and was navigated according to the menus below noting than future enhancement in the Wiki modify some menu aspects.

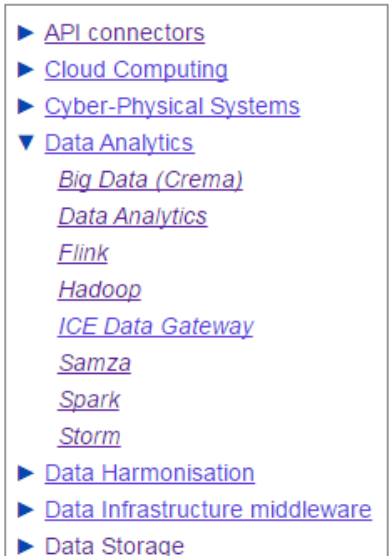


Figure 1. Navigation menu

Within each category there were entries with topics categorizing solutions, and in the case of existing relevant solutions, specific entries were introduced analysing that technology, some articles and references, projects or initiatives of interest using the technology and how the technology could provide value to vf-OS (see Figure 2 and Figure 3 for the Flink technology example).

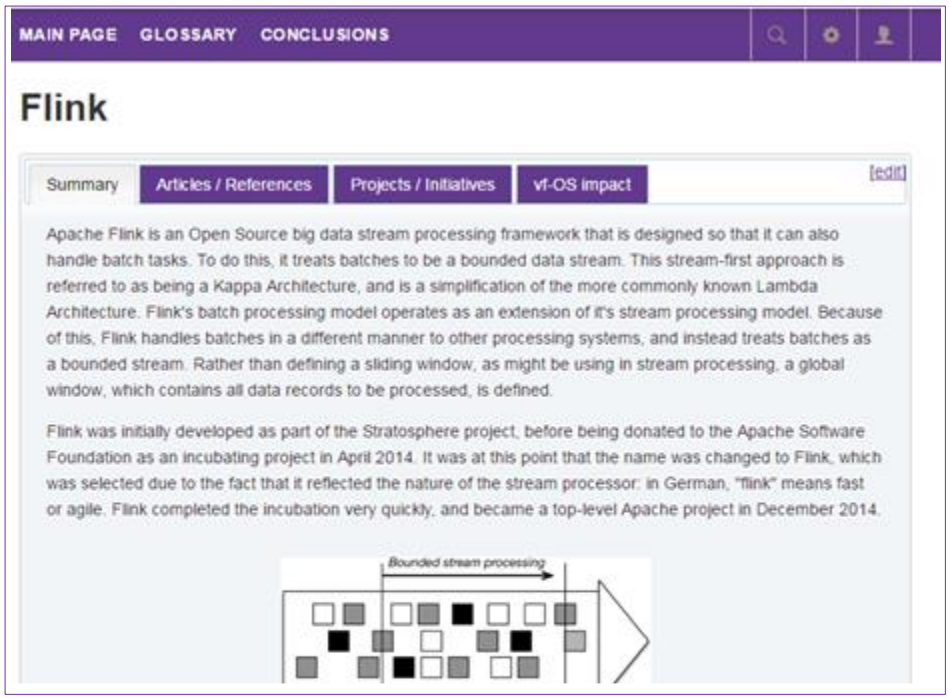
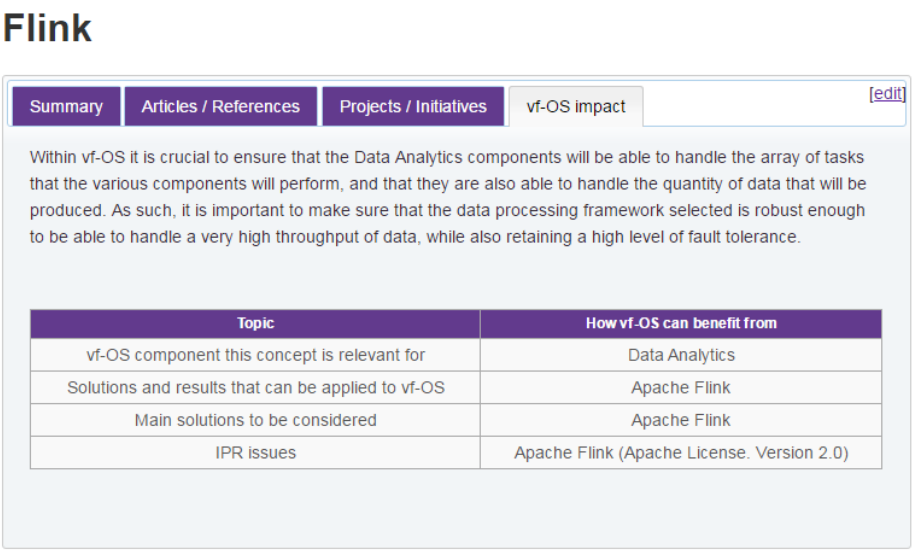


Figure 2. Summary of Flink technology entry



Flink

Summary | Articles / References | Projects / Initiatives | vf-OS impact [edit]

Within vf-OS it is crucial to ensure that the Data Analytics components will be able to handle the array of tasks that the various components will perform, and that they are also able to handle the quantity of data that will be produced. As such, it is important to make sure that the data processing framework selected is robust enough to be able to handle a very high throughput of data, while also retaining a high level of fault tolerance.

Topic	How vf-OS can benefit from
vf-OS component this concept is relevant for	Data Analytics
Solutions and results that can be applied to vf-OS	Apache Flink
Main solutions to be considered	Apache Flink
IPR issues	Apache Flink (Apache License. Version 2.0)

Figure 3. Analysis of flink impact on vf-OS

From the analysis of each technology done at the vf-OS impact tabs on the wiki (see one specific case in Figure 3) there were concluded a list of solutions/technologies (see Table 1) that were though to need a deeper research to select the definitive ones to be used when developing the vf-OS components at WP3-7.

Table 1. List of preliminary solutions to be considered

vf-OS component	List of solutions

vf-IO	• **API**: Swagger, Aerospike API, Google Firebase Database API, CachetHQ API
	• **Drivers**:
	  • M2M:MQTT, Mosquitto, Contiki, OPC UA, NodeOPCUA
	  • PLC: CODESYS PLCHandler, IEC 61131-3 Virtual Machine, IEC 61131-3 Spec, Twincat ADS Protocol
	  • RFID: TagCentric, Rifidi, Shopfloor Data collection (SFDC)
	  • SCADA: OPC UA, Mango
	  • Sensors: Waspmote, Scilab
	  • Standards: ISO 16100, IEC 61131-3, ISO/IEC 17963
	  • Wireless Sensor Networks: GSM, Waspmote, Nsmam
	• **IoT**: IoT Discovery , IoT Broker , Identity Management – KeyRock

vf-SK	• **Process Engine**: Activiti, CBPM
	• **Security and Data Access**:
	  • Authentication, authorization and accounting: FreeRadius, [Apache Rampart
	  • Cryptography: OpenSSL, NSS, EJBCA
	  • Information Security: SELinux, ISO 27000, IEC 62443,
	  • Mobile applications security: Google manifest specifications, WHQL model for the protection of drivers, W3C recommendation for HTML sandboxing

	• **Events/Messaging**: smart-ESB model, Secure Event Management (SEM), Dynamic CEP (DyCEP), JADE • **FITMAN Specific enablers**: Dynamic CEP (DyCEP), Semantic Mediator (SedMed), Collaborative Asset Management (CAM), Management of Virtualised Assets (MoVa),Shopfloor Data collection (SFDC), Dynamic Visualization and Interaction (DyVisual) • **FIWARE enablers**: IoT Discovery , IoT Broker , Identity Management – KeyRock, Cloud Messaging - AEON

vf-MW	• **Data Storage**:
	  • Data Query Platforms: Phoenix, Trafodion
	  • Distributed File Systems: HDFS, OpenStack-Swift
	  • New SQL Databases: CockroachDB
	  • NoSQL Data Storage Infrastructure: Hypertable, Cassandra, MongDB, Neo4J
	  • Spatiotemporal databases: Warp10
	
	• **Data Analytics**:
	  • Batch Processing Frameworks: Hadoop
	  • Hybrid Processing Frameworks> Flink
	  • Other projects' solutions: COMBILASER Self-learning system
	
	• **Data Harmonisation**: ICE Data Gateway, Talend
	• **Data Infrastructure middleware**: IDAS Backend Device Management, Orion Context Broker, zeroMQ, DDS, Talend, Global Sensor Network, Akka, CREMA MPM

vf-App	• **Standards identified on pilots**: IndoorGML,

vf-OAK	• **SDK & Studio**: Java SDK (JDK), Eclipse Platform, Android SDK and Studio, IBM Bluemix Cloud
	• **Front-End Environments**:
	  • Behaviour templates: Abcore
	  • Corporate Design: Electron, Ionic 2
	  • Dashboards: CREMA Dashboard
	  • Styleguide: Material Design, Human Interface Guidelines

vf-P	• **Architectures**: AUTOSAR, aXBench, FITMAN Smart Factory Reference Architecture • **Cloud Computing**: OpenStack, and some of its projects NOVA, NEUTRON, SWIFT, CINDER, KEYSTONE, GLANCE, HORIZON, HEA • **Platforms**: Eve Agent Platform

In addition to the results a project glossary was presented. As each deliverable is approved by the consortium for submission to the EU the editor of that document is mandated to update the Glossary with new terms (see figure 4 below) and potential changes to terms. The Glossary and these changes are audited by partner ALM. The Glossary can be accessed at www.vf-os.eu/Glossary:

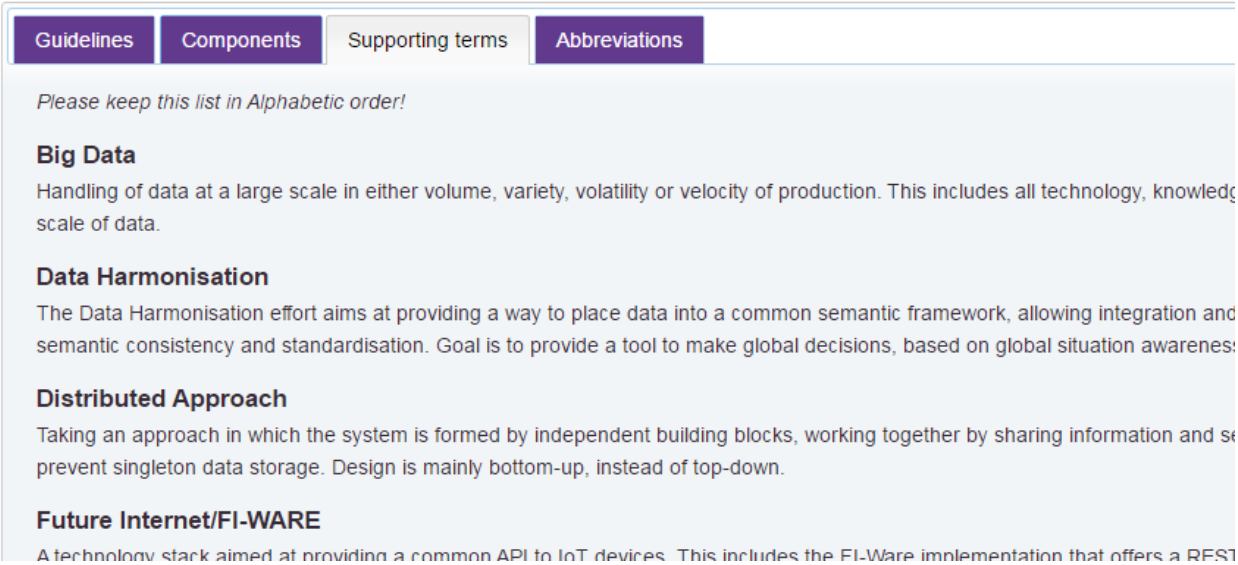


Figure 4. Glossary entry with terms supporting the deliverables

3 Wiki M18 Evolution and Conclusions

From the preliminary list of technologies identified at wiki M6 release, and after defining the vf-OS architecture D2.1, and the start of the technical work packages WP3 to 7, there was a refinement the Wiki related to this document. This included refinement of the technologies researched and a further selection performed because of a more detailed work on the different components' architectures carried out at WP3-7. This alignment has also matured along with a refined version of the architecture D2.1 and the decision of whether to buy, partially use or 'skip' certain approaches initially thought valid. Note though that D1.4b's emphasis, although aligned, is focused on the functional description of existing solution, the comparation and the final selection of technologies (see Figure 5).

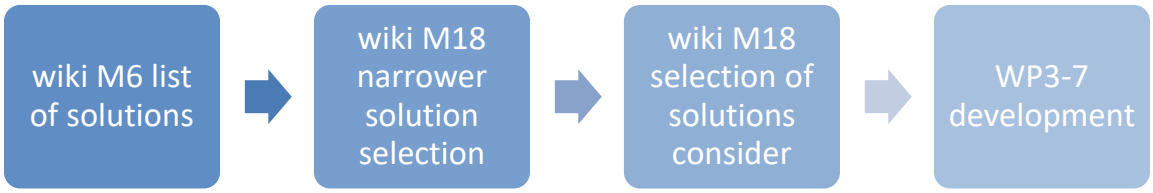


Figure 5: Wiki SOTA analysis evolution

Technologies selected were analysed more deeply in the light of their usage in the support of vf-OS components development, and then a filtering of the previous list of applicable solution, together with the addition of some technologies that were not considered has been performed. That result is accessed via in a new menu/section named vf-OS technology foundation (see Figure 6).

Figure 6: New wiki section

This new section explains, in a per vf-OS component basis, the comparation of updated technologies based on the work initiated in each RTD workpackage (see Figure 7).

vf-OS platform | OAK Toolkit | Engagement | Middleware | Data Management | I/O Toolkit [edit]

Control | Marketplace Services

Marketplace

The vf-Store will be the core component for additional services that go beyond the core functionalities of vf-OS. Users will be able to browse existing vf-OS Assets based on characteristics of the vf-OS Assets such as their price or category. After that the user will be able to purchase vf-OS Assets as, for example, a one-time fee43 or on a pay-per-use basis, and acquire those. To support pay-per-use, interfaces will be provided to keep track of the remaining usages of a vf-OS Assets.

Following, there are the final list of technologies analysed for the development of the Marketplace bolding the ones that have been picked and are used (click on them if you want a deeper analysis).

Solution	Functionality	Evaluation
Shopware	Marketplace Content Manager, Order Manager, Invoicing	+
Ascora FIPS		+++
Fuse	vf-Store Frontend UI & vf-Store Administration UI	+++
Discourse	Negotiation Environment	++

Figure 7: Marketplace services section

From the analysis, a selection of solutions was made based on the vf-OS project expert analysis and that is represented in the tables with bolder letters (eg Ascora FIPS in Figure 7).

New entries that were previously not considered have been introduced. It is the case of Ascora FIPS technology (see Figure 8).

Ascora FIPS

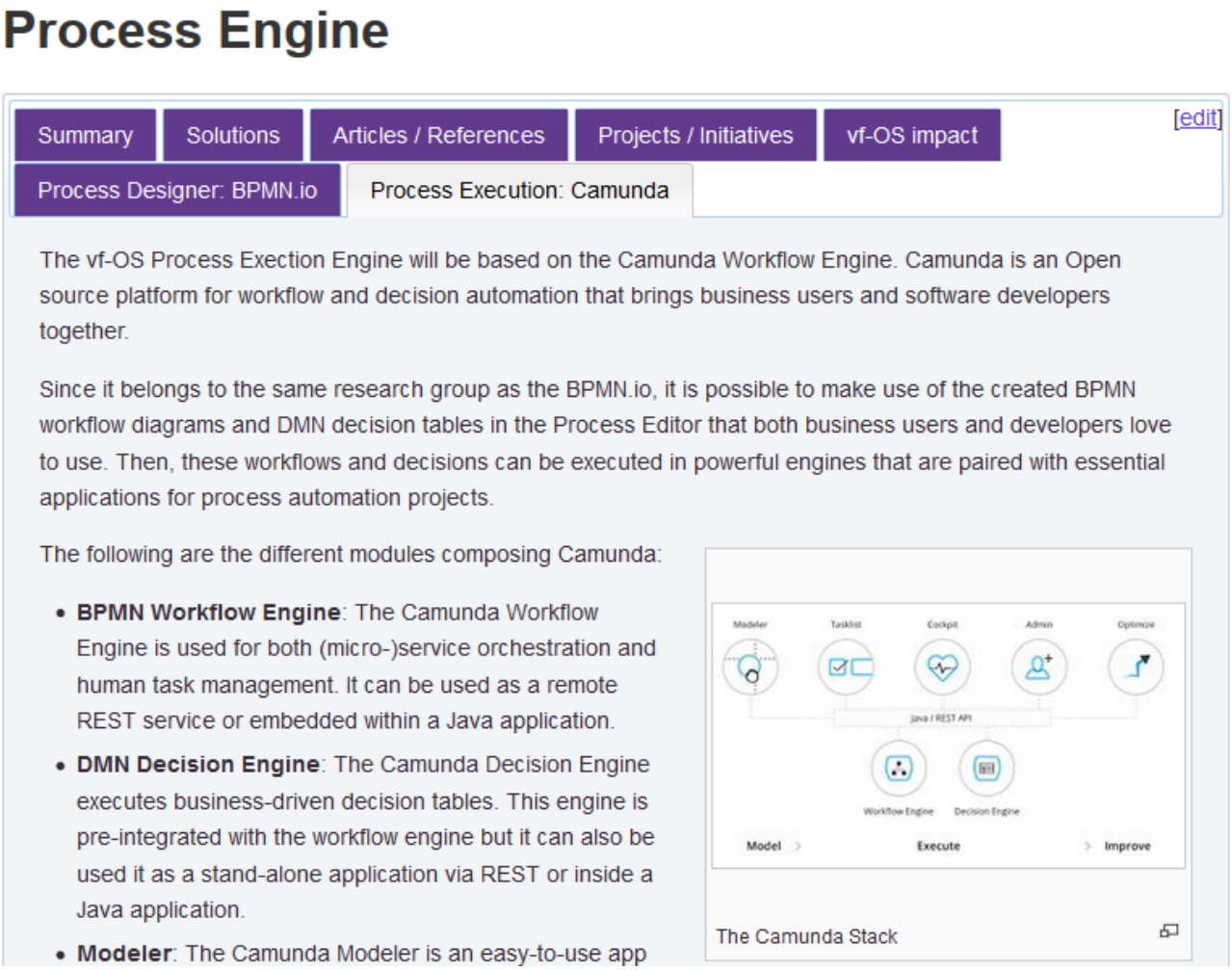
Summary | Modules | Articles / References | Projects / Initiatives | vf-OS impact [edit]

Ascora FIPS is a customer and order management system developed by partner Ascora. It offers the possibility to automatically create a large number of new customers and manage their respective software licenses. It currently supports various types of licenses such as time-limited or unlimited. The results from vf-OS will be used to extend the existing Ascora FIPS.

Figure 8: Ascora FIPS new entry

Finally, new tabs explaining how selected technologies are meant to support the vf-OS components according to the work already started in RTD WPs were created. For

example, Figure 9 shows how Camunda is being used on WP5 for developing the vf-OS process engine.



Process Engine

Summary | Solutions | Articles / References | Projects / Initiatives | vf-OS impact [edit]

Process Designer: BPMN.io | Process Execution: Camunda

The vf-OS Process Exection Engine will be based on the Camunda Workflow Engine. Camunda is an Open source platform for workflow and decision automation that brings business users and software developers together.

Since it belongs to the same research group as the BPMN.io, it is possible to make use of the created BPMN workflow diagrams and DMN decision tables in the Process Editor that both business users and developers love to use. Then, these workflows and decisions can be executed in powerful engines that are paired with essential applications for process automation projects.

The following are the different modules composing Camunda:

- **BPMN Workflow Engine**: The Camunda Workflow Engine is used for both (micro-)service orchestration and human task management. It can be used as a remote REST service or embedded within a Java application.
- **DMN Decision Engine**: The Camunda Decision Engine executes business-driven decision tables. This engine is pre-integrated with the workflow engine but it can also be used it as a stand-alone application via REST or inside a Java application.
- **Modeler**: The Camunda Modeler is an easy-to-use app

Figure 9: Camunda more detailed analysing under the vf-OS process engine functional needs

4 Version Changes

This document (D1.4b) is one of a series of three deliverables (D1.4abc) for delivery in the project at M6, M18 and M30. As such, this document includes major changes (eg additional subject areas or dropped technologies) in the following sub-sections as well as any changes suggested by reviews.

4.1 M18 Changes

- Renaming of M6 conclusions tab as 1st analysis
- Creation of new vf-OS Technology Foundation section where deeper analysis of most relevant technologies was done. That selection is a subset of M6 previous list, extended with new technologies that were not considered in M6.
- Selection of technologies after comparation
- New entries with technologies that were not considered (eg Ascora FIPS)

- New tabs on previous entries explaining how the selected solutions are used on each technical workpackage to build their specific vf-OS component

4.2 M30 Changes

[For version D1.4c]

5 Conclusions

The vf-OS Wiki and its analysis of the existing solutions are the grounding to the technology solutions covered in vf-OS – virtual factory Operating System. The deliverable is a brief overview of the wiki evolution since M6 previous version. This deliverable is for administrative purposes only and the 'real' deliverable is the vf-OS wiki itself at www.vf-os.eu/wiki.

The Wiki covers a range of solutions, standards, commercial solutions, and open source solutions which could have an impact on the vf-OS set of solutions. These set of solutions are grouped according to the topic and knowledge area they are part of. For each topic/knowledge area, a description of the topic is provided, as well as a list of categorised solutions. Articles and references supporting the description are identified, projects and initiatives that are a reference in the knowledge area are listed and finally a deeper analysis on how some of the solutions identified are of relevance to applicable components of the vf-OS project.

This document is one of a series of three deliverables (D1.4abc) for delivery in the project at M6, M18 and M30. It is noted that the vast majority of the Wiki work, circa 80-90%, was for reporting in D1.4a.

This deliverable update's the previous conclusions according the refinement work performed in WPs3-7. There the initial list of solutions pinpointed in D1.4a were critically reviewed, a narrower and deeper analysis was taken out and a final selection of technologies was done. The remaining deliverable is to provide updates due to the evolution or augmentation of the technologies and subjects investigated and thus ensure the partners knowledge (and Wiki) are 'current'. As such, further iterations of this document will include the major changes (eg additional subject areas or dropped technologies).

Annex A: History

Document History	
Versions	NB: This concerns the document only and not the Wiki itself V0.9.x: • Draft versions V1.00: • Pre-Final Version (including review) V1.01: • Final Version (including review)
Contributions	UPV: • Victor Alonso Anaya Fons ICE: • Stuart Campbell

Annex B: References

None

Annex C: Wiki How To

See next pages.

vf-OS: virtual factory Operating System

Vf-OS: Wiki How To

1 Guidelines

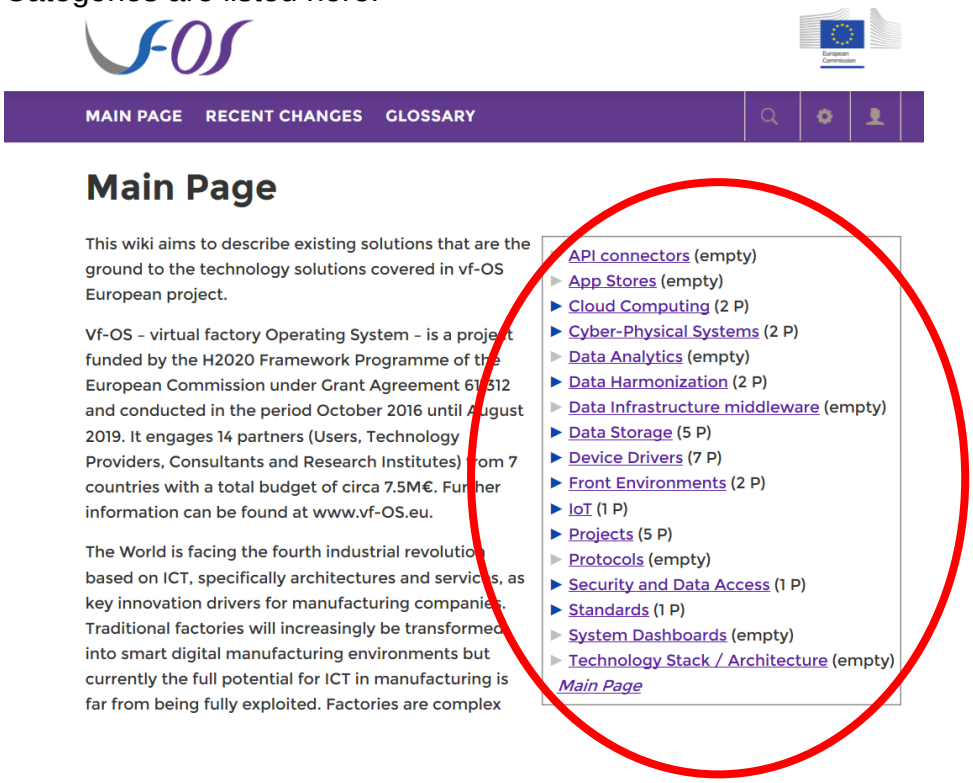
The Wiki is the main result of task 1.4 and it is a deliverable, which means that though it is a wiki, the content should have the same quality as a deliverable. The Wiki is regarding existing related solutions and giving ground to technologies that vf-OS build on top of them, or vf-OS integrates with them, or technologies in the same knowledge area as vf-OS.

As far as there are many technologies that could be related with vf-OS, solutions are grouped in topics (eg PLC, networked sensors, etc). Topics are associated to a page on the Wiki. A given topic (eg PLC) has a summary tab, a solutions tab, an articles/references tab, a projects/initiatives tab and a vf-OS tab – see below for further details.

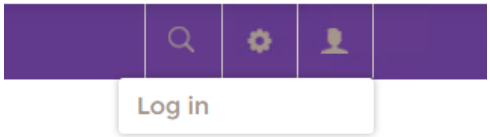
Topics are the main area where content is found, however topics are also grouped in categories to make navigation of the Wiki easier. Categories are similar to folders in computers, and topics are in this case 'files'. Categories only have a general description (half to one page), but solutions, articles, vf-OS impact, etc are created on pages, not in categories.

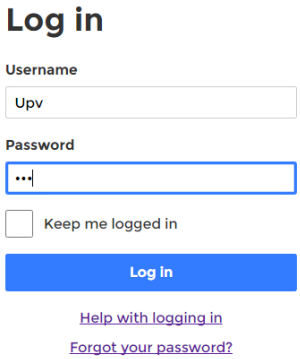
If there is a need for further categories or subcategories, the Wiki lead should be contacted (vicanfon@upvnet.upv.es).

Categories are listed here:

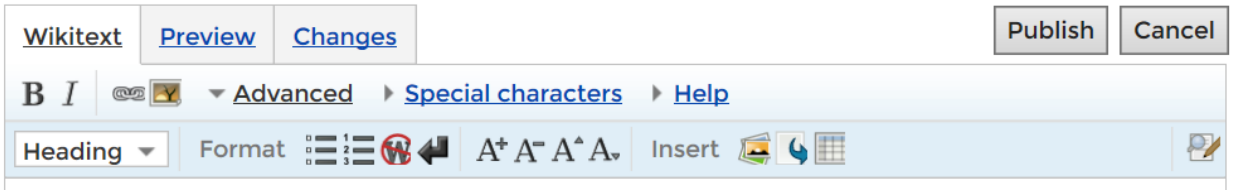


In order to create content an editor must log into the system.



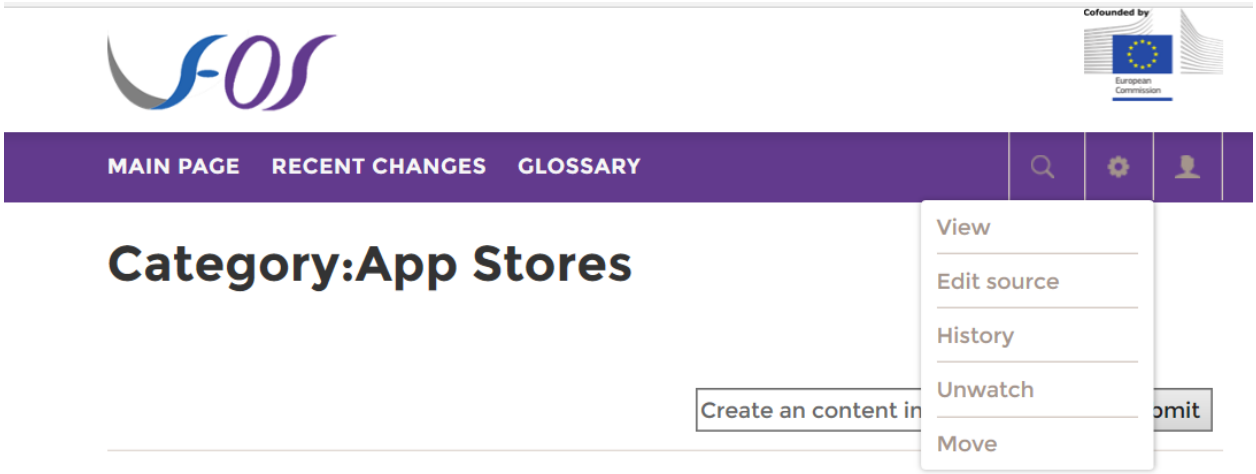


Writing on a wiki is not as user friendly as writing on Word. vf-OS wiki makes use of a specific syntax using specific symbols for including images, bolding words, etc. For this reason, a plugin has been added that makes access to the options easier.


Wikitext
Preview
Changes
Publish
Cancel
B I
Advanced
Special characters
Help
Heading
Format
Insert

2 Describe the Main Category

Navigate to the relevant category and if logged in click on the option edit source under the “cog’ icon.

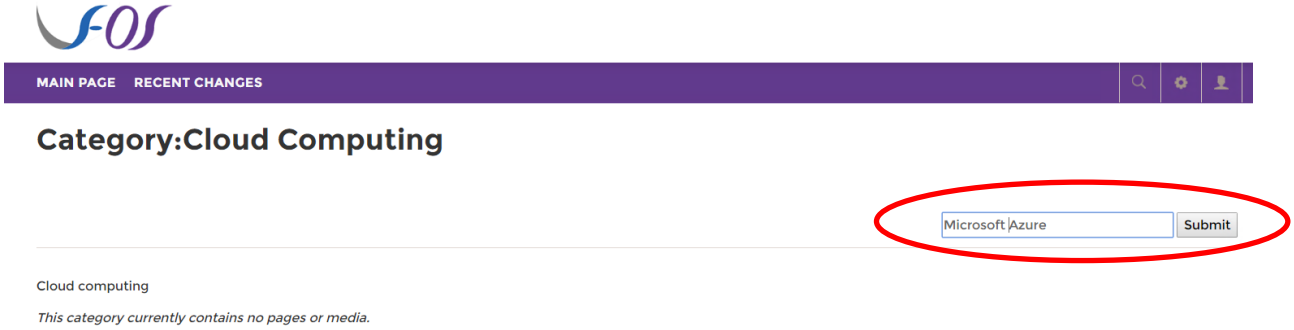


The content expected is the following:

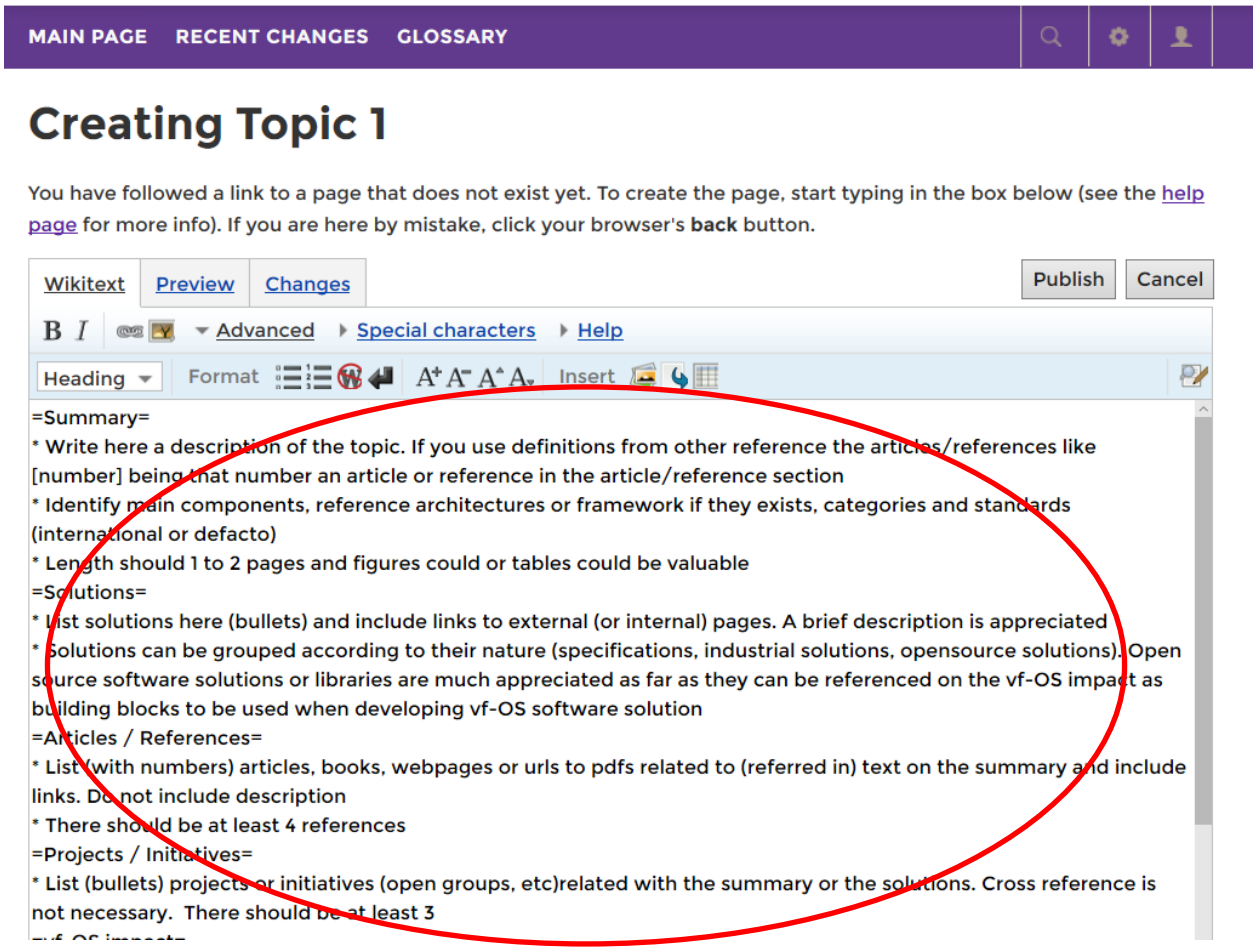
```
You are in a category. Categories group pages of specific areas of knowledge,
and a way to classify pages where the real extensive content is written.
Write here a description of this area of knowledge and main topics and maybe
their relationship. Then create using the textbox at your right pages for every
main topic of this category.
Pages will hold the real information with the description, solutions,
articles/references, projects and vfOS impact.
```

3 Create and describe topics under a category

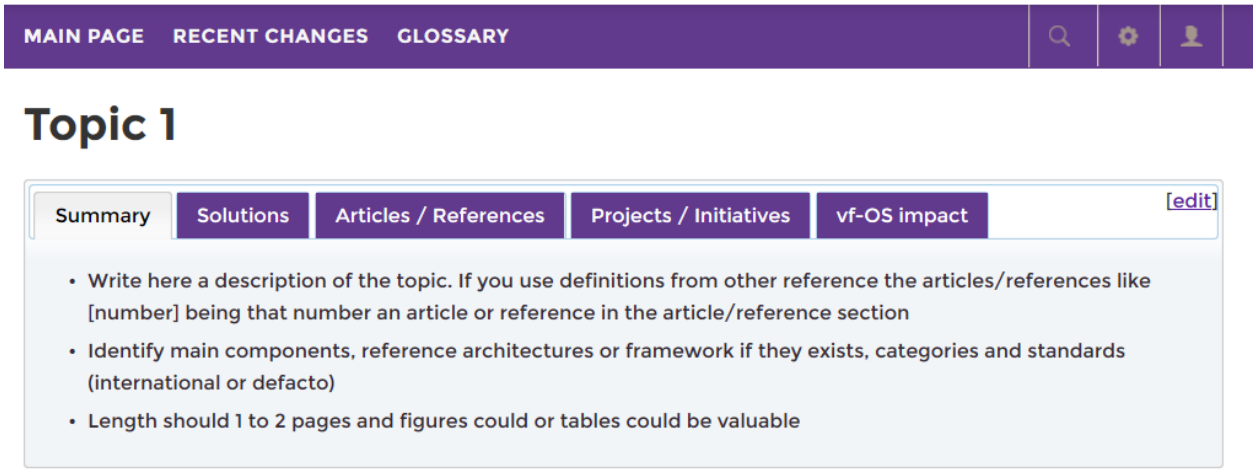
In a given category you can create a topic regarding that category. This is done by writing the name of the topic on the box at the top right and clicking submit.



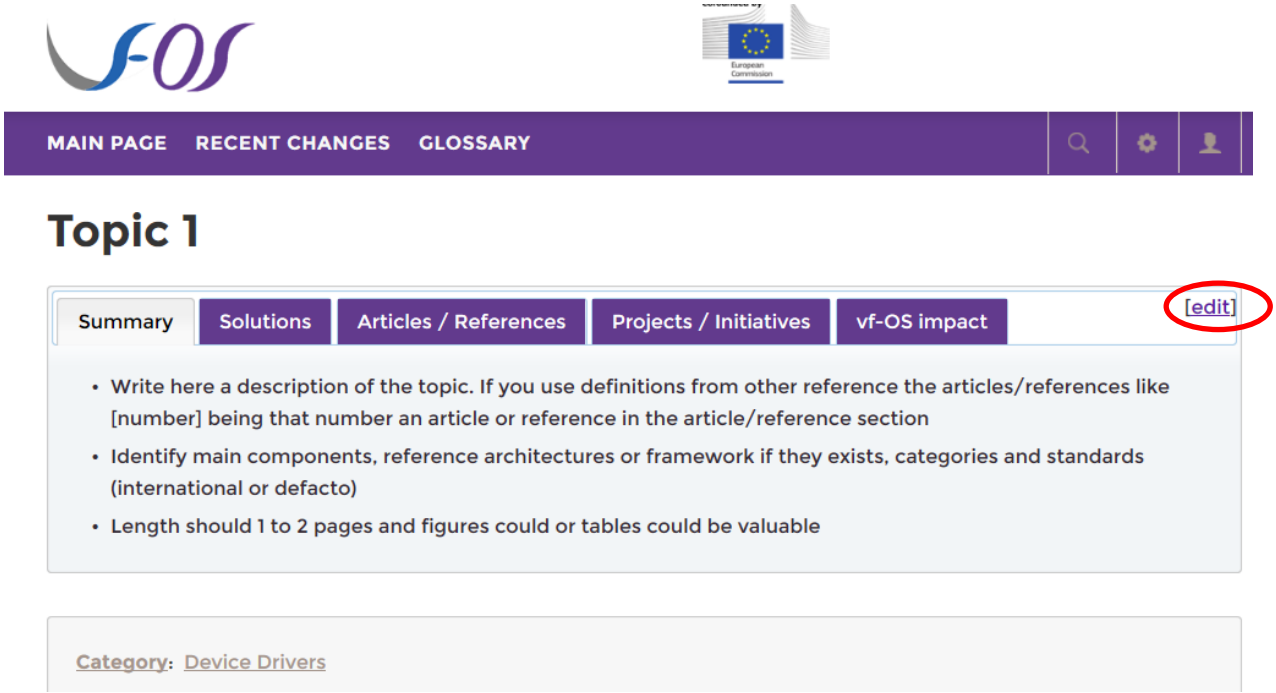
The system will create a page for the topic we want to write and will use a template. However the page that appears here uses mediawiki scary language. It is better if you click on this page publish to get a friendlier page.



After publishing the friendlier view of the template is displayed. From here navigate to each tab to be filled. Below is an explanation of information to be gathered and extensions to be achieved.



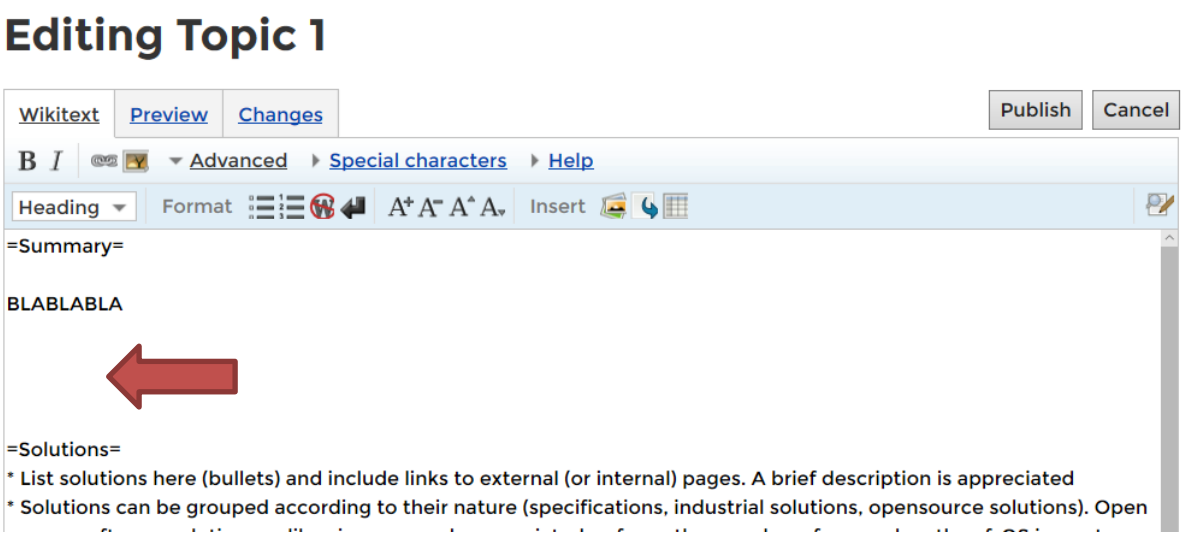
To write a given section click first on the tab (section) and then click the link button at the right. Fill only the content of this tab. Follow the guidelines written on the tab.



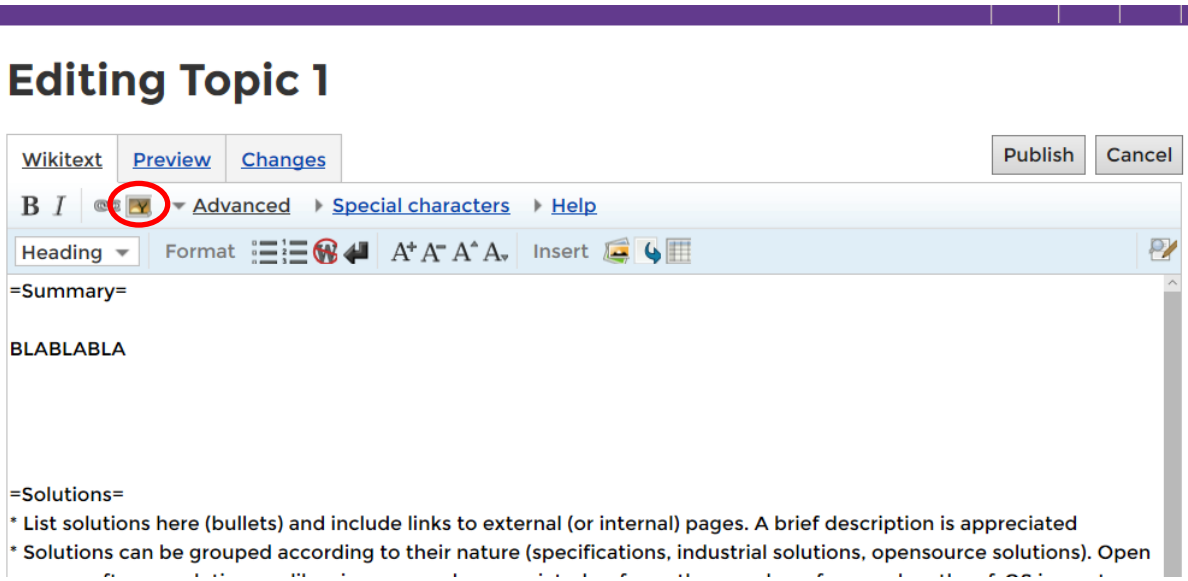
Examples to be considered when writing your own content are:
http://158.42.105.151/mediawiki/index.php/Machine_to_Machine_communication
and
http://158.42.105.151/mediawiki/index.php/PLC

4 Other editing issues

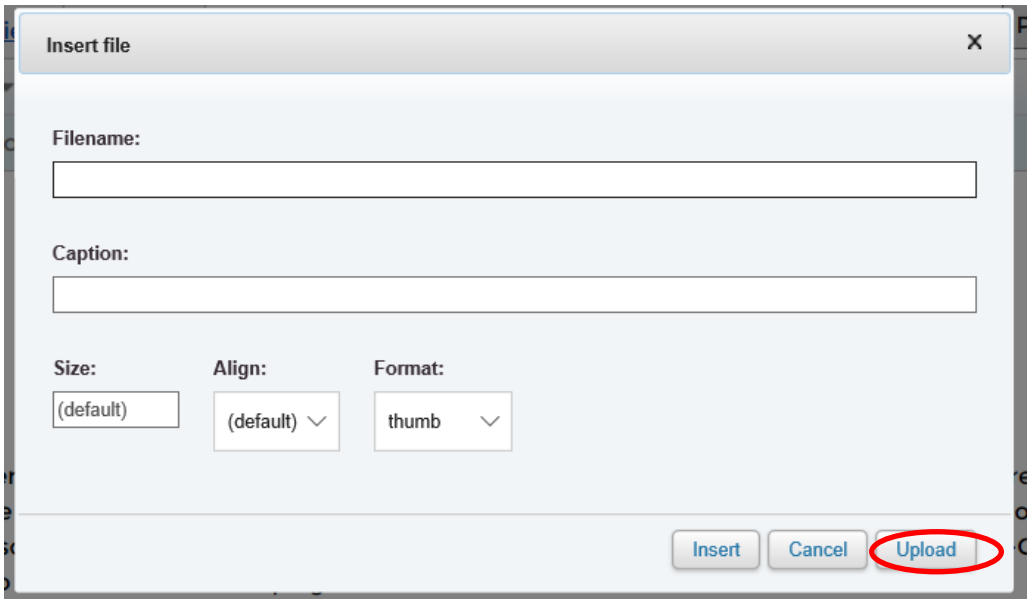
In order to add an image to a section (with architectures, frameworks, etc), first make sure that the image is of a reasonable size (400x400, or similar). If a bigger image is used and it is resized via the Wiki editor it will identify an error so instead change the size using an image editor such as GIMP beforehand. With the image ready, navigate to the page and section, and while editing, position the cursor on the line where the image is to be added.



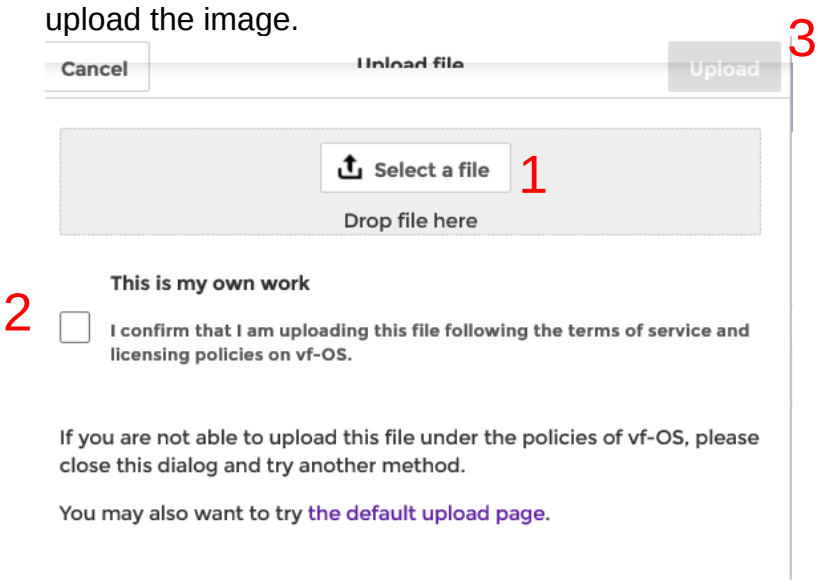
Click on the image icon on the ribbon.



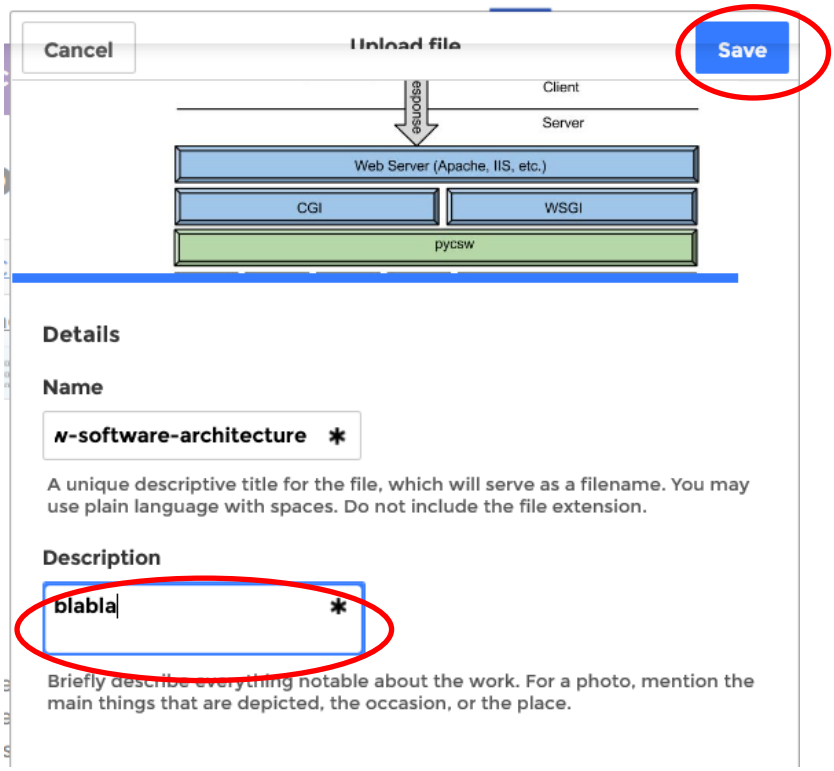
A popup appears, click on the upload button.



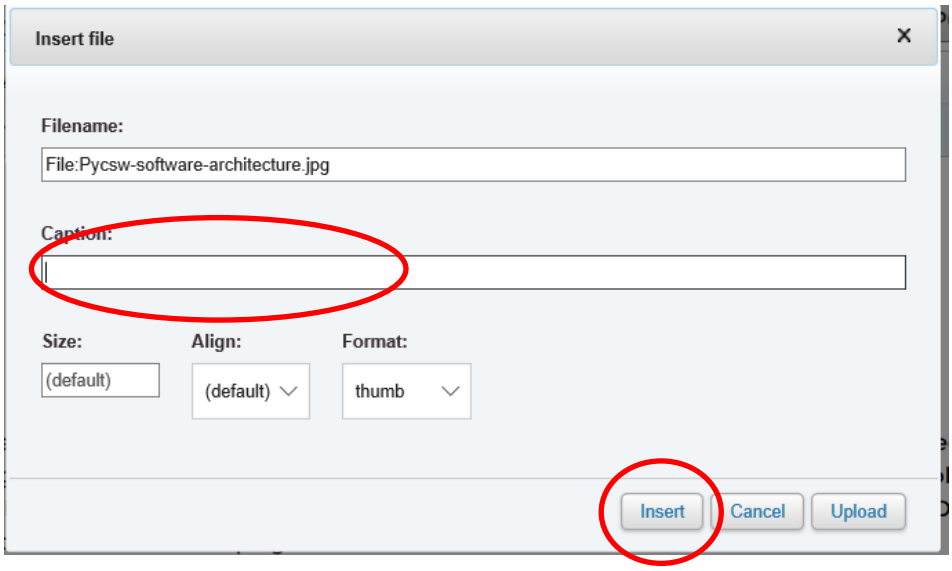
Browse the hard drive to the image to select the file. Check also the box below and then upload the image.



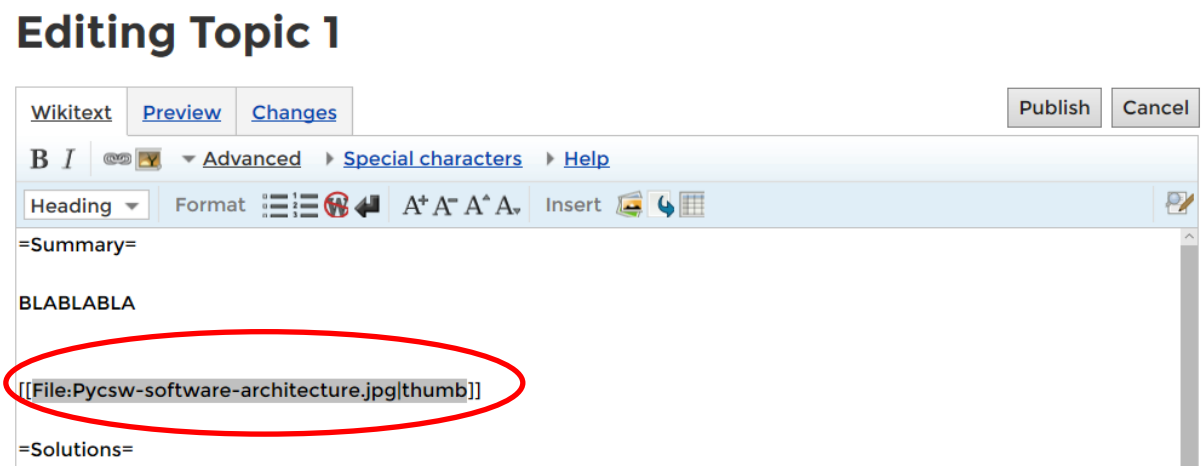
Write the description and save.



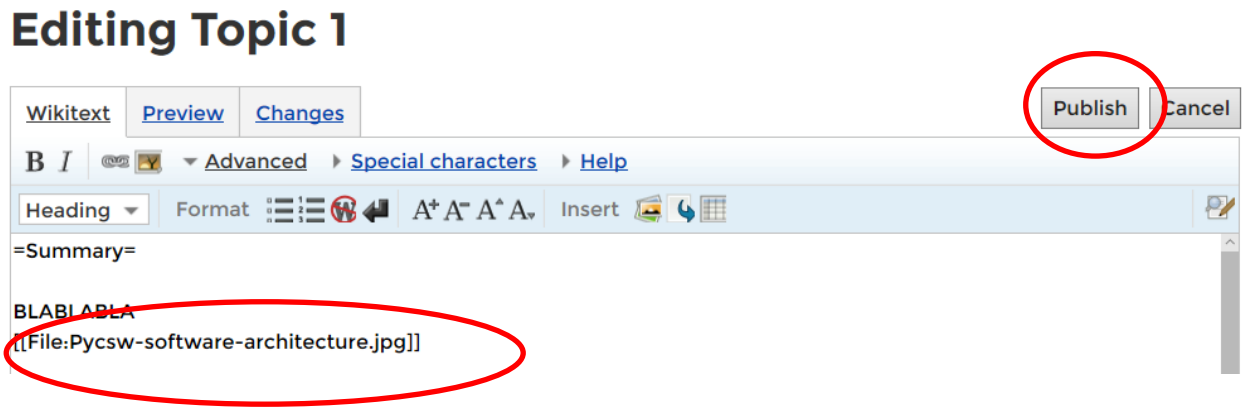
Write a name for the caption as necessary and press insert.



The mediawiki syntax is then inserted. Do not press publish yet.



Next ~~Then,~~ delete the '~~|~~thumb' section and click publish.



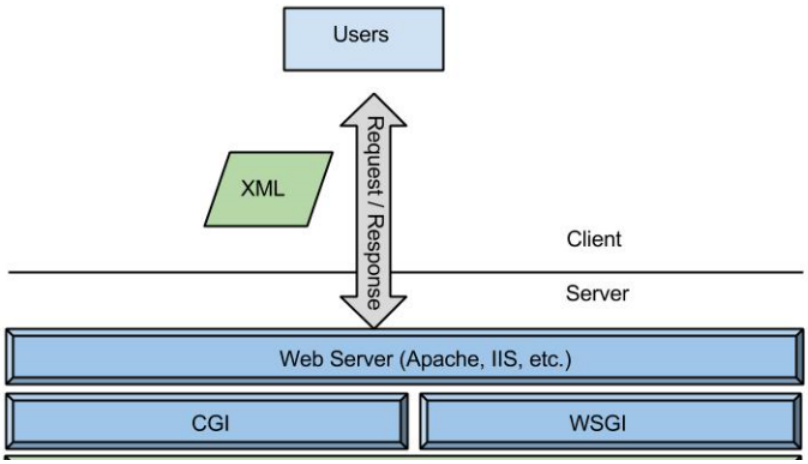
The image will be loaded.~~:~~

MAIN PAGE RECENT CHANGES GLOSSARY

Topic 1

Summary | Solutions | Articles / References | Projects / Initiatives | vf-OS impact [edit]

BLABLABLA



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