CEDR

Conférence Européenne
des Directeurs des Routes

Conference of European
Directors of Roads

INFRACOMS

Innovative and Future-proof Road Asset Condition Monitoring Systems

Appraisal Toolkit User Manual

Deliverable D2.2

Final Version 1.0

September 2023

TRL THE FUTURE OF TRANSPORT

COWI

ZAG

vti

Belgian Road Research Centre
Together for sustainable roads

TU Delft

DANISH TECHNOLOGICAL INSTITUTE

Project acronym: INFRACOMS

Innovative & Future-proof Road Asset Condition Monitoring Systems

Report D2.2

Final Version 1.0

Appraisal Toolkit User Manual

Start date of project: 15.06.2022 End date of project: 14.06.2024

Authors:

Arvidsson Anna, VTI, Sweden
Kokot Darko, ZAG, Slovenia
Anžlin Andrej, ZAG, Slovenia
Lundberg Thomas, VTI, Sweden
Vezočnik Rok, ZAG, Slovenia
McPherson Kevin, TRL, United Kingdom
Fjendbo Simon, DTI, Denmark
Lee Rob, TRL, United Kingdom
Saberi Mogens, COWI, Denmark
Tunholm Mattias, VTI, Sweden
Van Geem Carl, BRRC, Belgium
Wright Alex, TRL, United Kingdom
Workman Robin, TRL, United Kingdom
Yang Yuguang, TU Delft, the Netherlands
Zhang Fengqiao, TU Delft, the Netherlands

Table of Contents

List of Figures

Abbreviations

Abbreviation	Definition
INFRACOMS	Innovative & Future-proof Road Asset Condition Monitoring Systems
TRL	Technology Readiness Level
WP	Work Package

1 Introduction to the Project

The application of consistent, reliable information has been a key component of highway asset management for over 40 years. The information and the tools to help collect, interpret and apply data have continuously evolved during that time. Technologies with the potential to support asset management include remote sensing, intelligent infrastructure monitoring, crowdsourcing, data analytics and visualisation. However, National Road Authorities (NRAs) are not yet fully exploiting their potential in the highway environment to better understand highway assets and to improve both reactive and proactive asset management decisions.

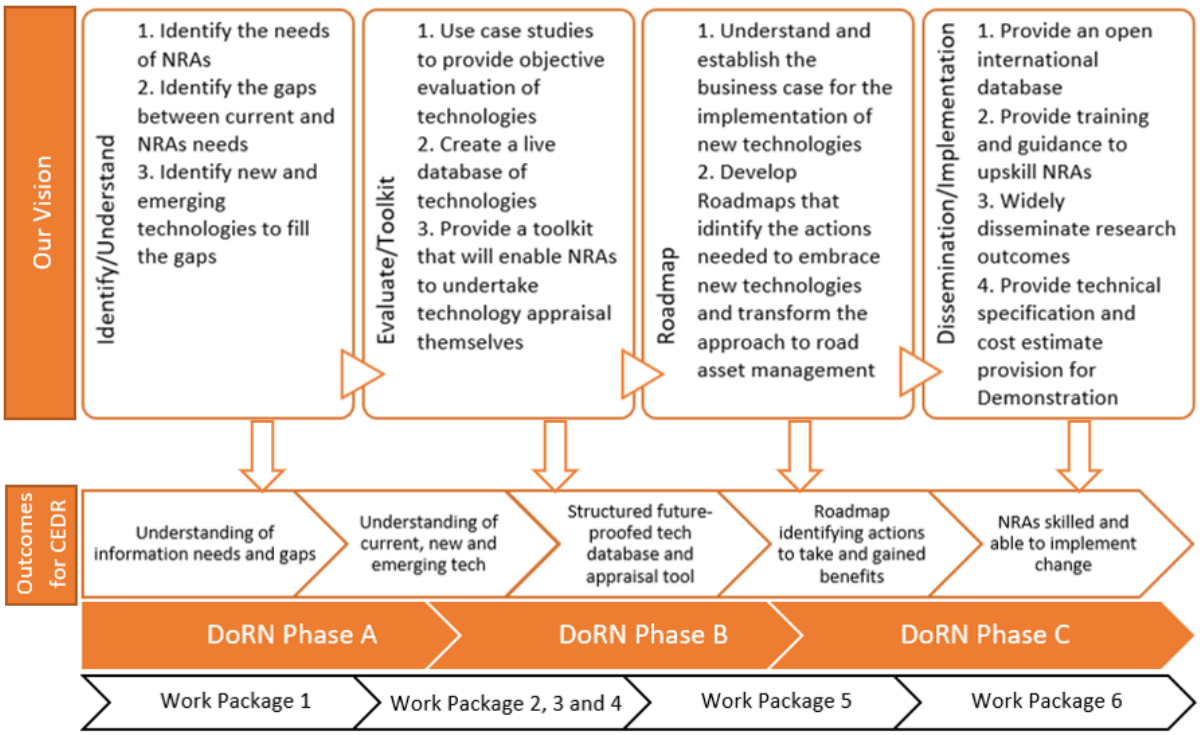


Figure 1. Vision and outcomes of INFRACOMS.

INFRACOMS aims to equip NRAs with the ability to better leverage the technological evolution in data and monitoring. Figure 1 summarises the approach being taken in this project. INFRACOMS is investigating the capabilities and benefits of technologies for understanding the performance of highway assets. INFRACOMS is establishing a database of new technologies and a toolkit to appraise them, to help NRAs assess the costs, benefits and limitations of applying these technologies in their own environments. INFRACOMS will also provide a roadmap to provide strategy and guidance for NRAs to improve their business processes for more effective assessment and implementation of new technologies.

This report represents the User Manual for the INFRACOMS Appraisal Toolkit as developed under Work Package 2.

2 Overview of the INFRACOMS Appraisal Toolkit

The INFRACOMS Appraisal Toolkit provides a database of technologies that are of potential use to National Road Authorities (NRA). It allows review and appraisal of those technologies using the methodology developed under INFRACOMS.

The toolkit has been created using the Confluence platform. Confluence is a wiki solution that is part of the Atlassian suite of products. A wiki is a website or online resource that can be edited by multiple users. Wikis are intended to be used by organisations or projects to manage information, and to enable teams to share knowledge and to work together in a collaborative manner.

The toolkit is accessible through a web browser. Figure 2 shows the home page or entry point for the toolkit. The web address of the toolkit is emailed automatically to any new user once that user is invited to access the platform (see Chapter 5).

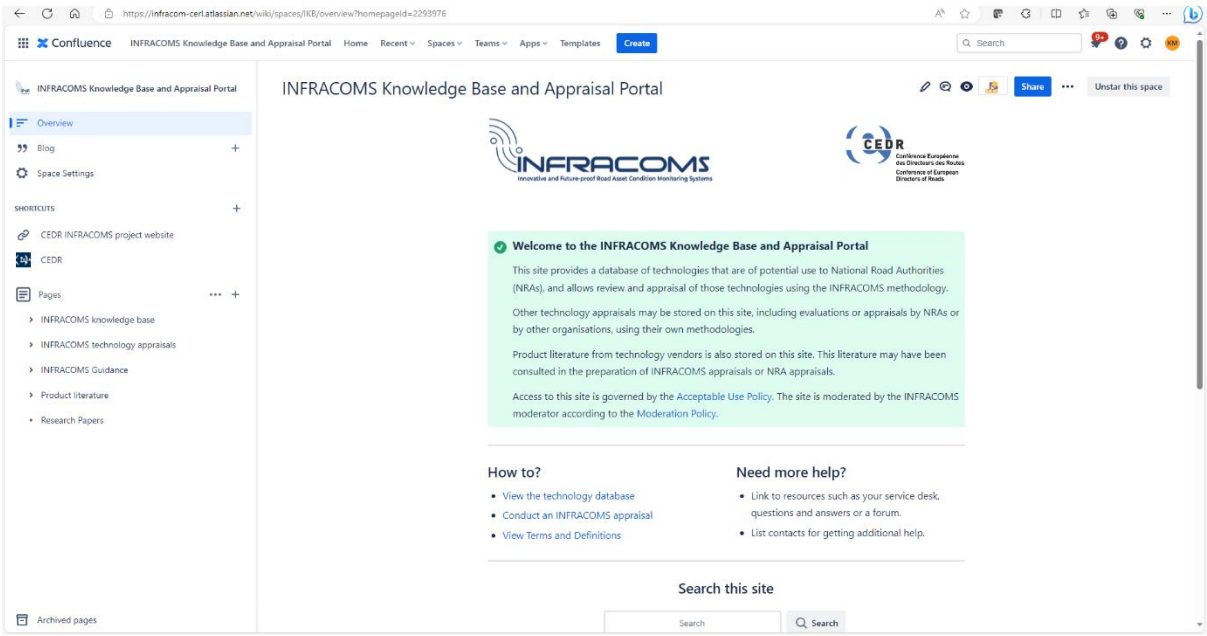


Figure 2. Home page for the INFRACOMS Appraisal Toolkit

The graphical user interface is very user-friendly. Functionality is provided through point-and-click menus or links, and basic word-processing functions. There are many ways of finding help, including via on-line resources.

The toolkit also contains a guidance section. All INFRACOMS deliverables, including this user manual, have been uploaded to the Guidance section of the toolkit. See Figure 2. It gives general guidance on use of the toolkit, explanation of key concepts (such as Technology Readiness Levels, Data Architectures), and key features of the toolkit (such as recommendations on Page Labelling).

INFRACOMS also has an acceptable use policy so that users understand the purpose of the site and the rules governing the moderation and administration. A basic acceptable use policy and moderation policy have been established for INFRACOMS and are accessible from the home page. These should be reviewed and extended in future as more users and organisations are granted access. It is available from the overview page.

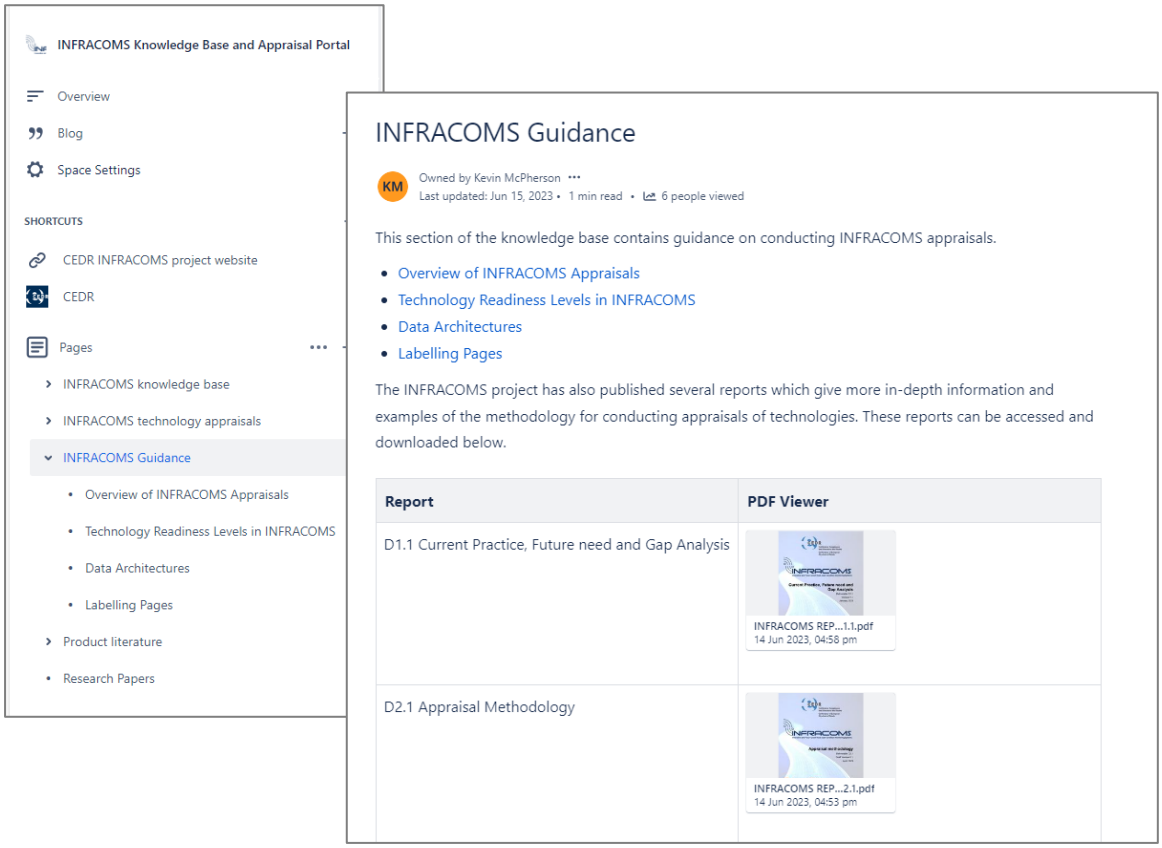


Figure 3. INFRACOMS Guidance

The remainder of this manual is structured as follows:

- Chapter 3 describes the three main functions of the toolkit: the Knowledge Base, Appraisals, and Case Studies.
- Chapter 4 describes standard wiki functions including editing, reviewing and commenting on content in the toolkit.
- Chapter 5 descibes Security and Administration inlcuding adding users.
- Chapter 6 provides information about the Confluence platform on which the toolkit is implemented. This chapter is primarily for use by Site and System Administrators.
- Chapter 7 contains an index for terms and functions in the toolkit.

3 INFRACOMS Appraisal Toolkit

The INFRACOMS Appraisal Toolkit consists of three main components: the Knowledge Base, Appraisals, and Case Studies.

Note that some functions may not be visible or may be disabled for some users depending on the security permissions assigned. For any questions ask the Site Administratoror see Chapter 5 Security and Administration.

3.1 Knowledge Base

The INFRACOMS Knowledge Base is a collection of pages containing information on the technologies that have been appraised for NRAs under INFRACOMS.

3.1.1 Explore the Knowledge Base

There are multiple ways to explore the Knowledge Base.

Side menu bar

The side menu bar (see Figure 4) should always be visible from any point in the toolkit. Click on any of the content in the menu bar to bring you to the appropriate page. The paeg may expand the page to show sub-headings under that particular category. Click the heading or sub-heading to expand or contract the material (see Figure 5) and view relevant material there.

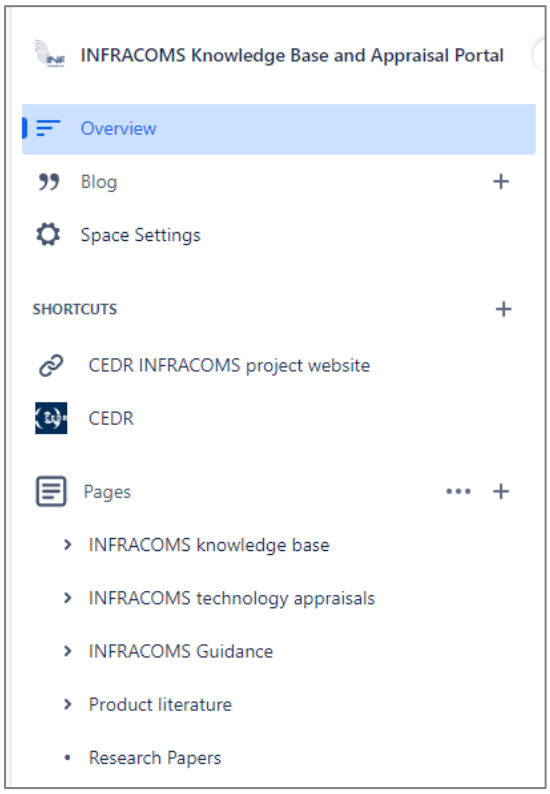


Figure 4. Side menu bar

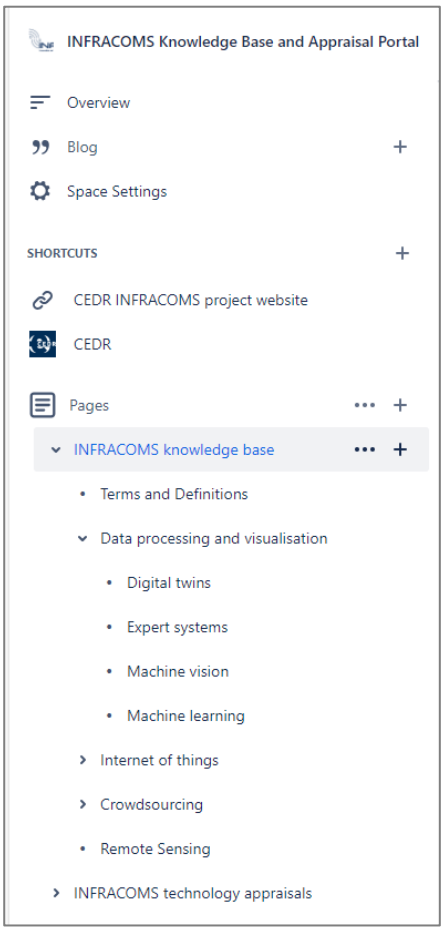


Figure 5. Expand headings in the side menu bar

Click on the INFRACOMS Knowledge Base, for example, and navigate to Data Processing and visualisation, to bring up content relating to Digital Twins, Machine Learning, Machine Vision etc. that has been created under the INFRACOMS project (see Figure 6). All information in the Knowledge Base relates to technologies identified under INFRACOMS WP1 new and emerging technologies. This information can be edited, commented upon, and added to in future using standard wiki functions (see Chapter 4).

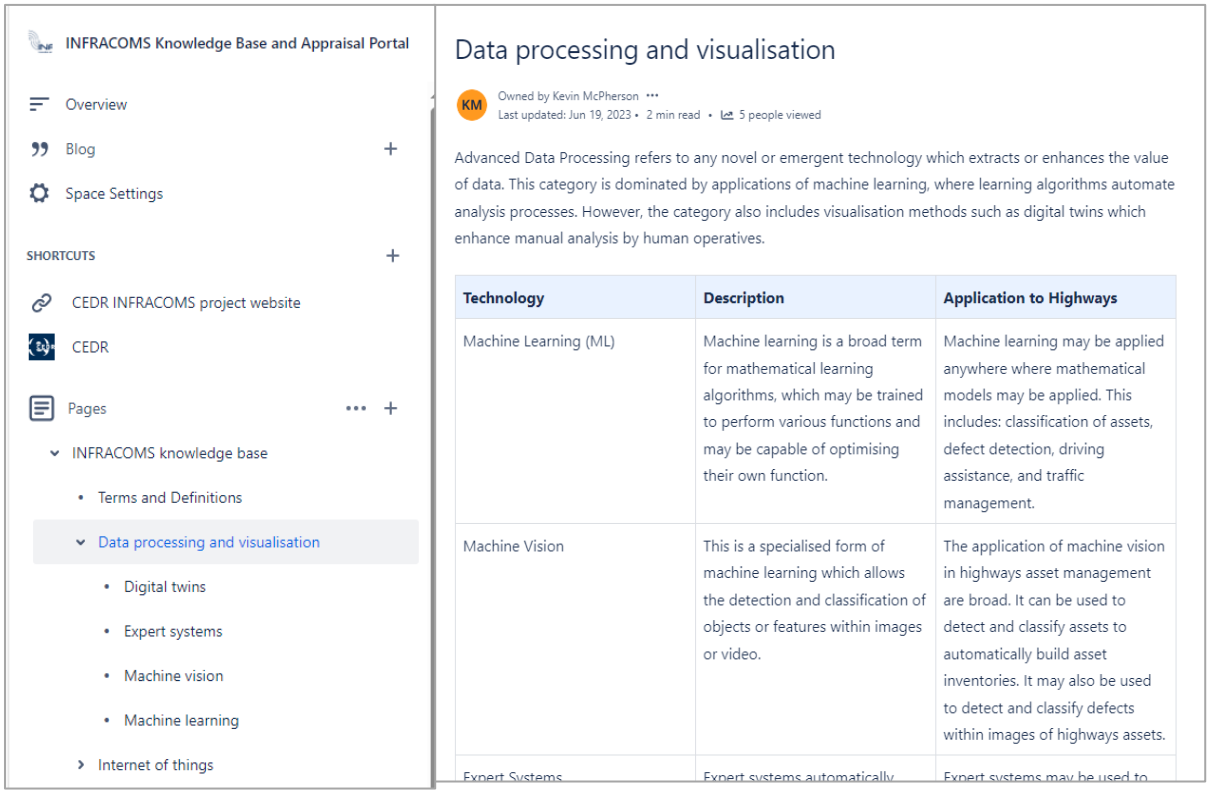


Figure 6. Explore the Knowledge Base

Search and browse by page label functions

From any point in the toolkit, click the Overview in the Side Menu Bar (see Figure 7) to access the home page. Then, from the home page, scroll down to the bottom half of the page to locate the search and browse by page label functions (see Figure 8).

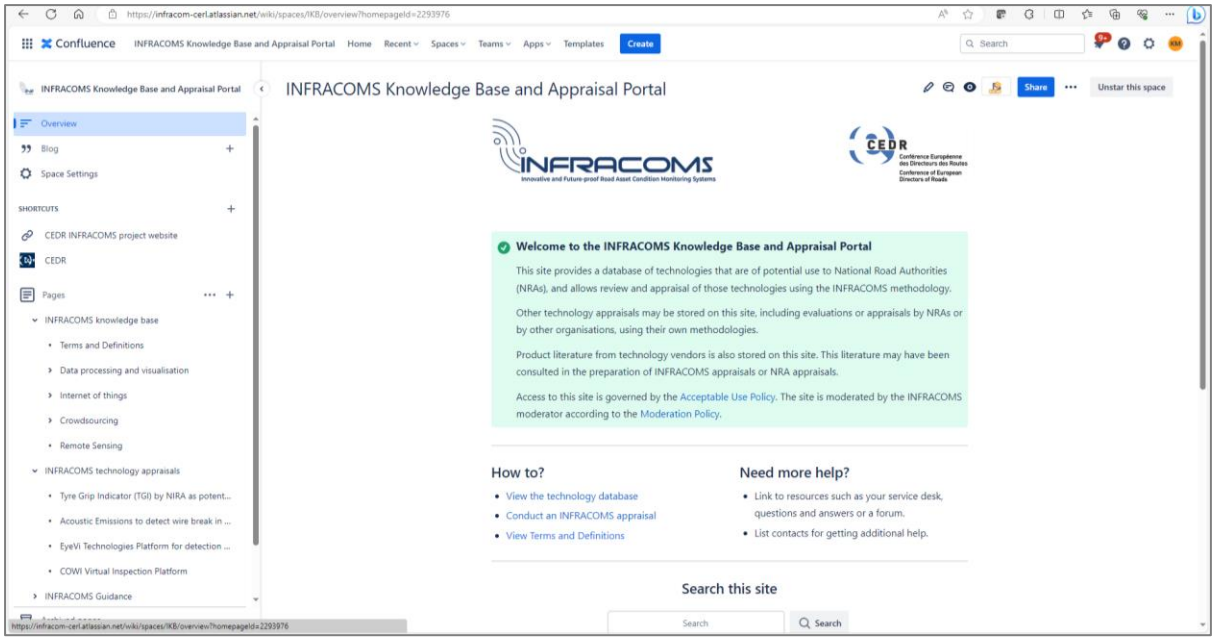
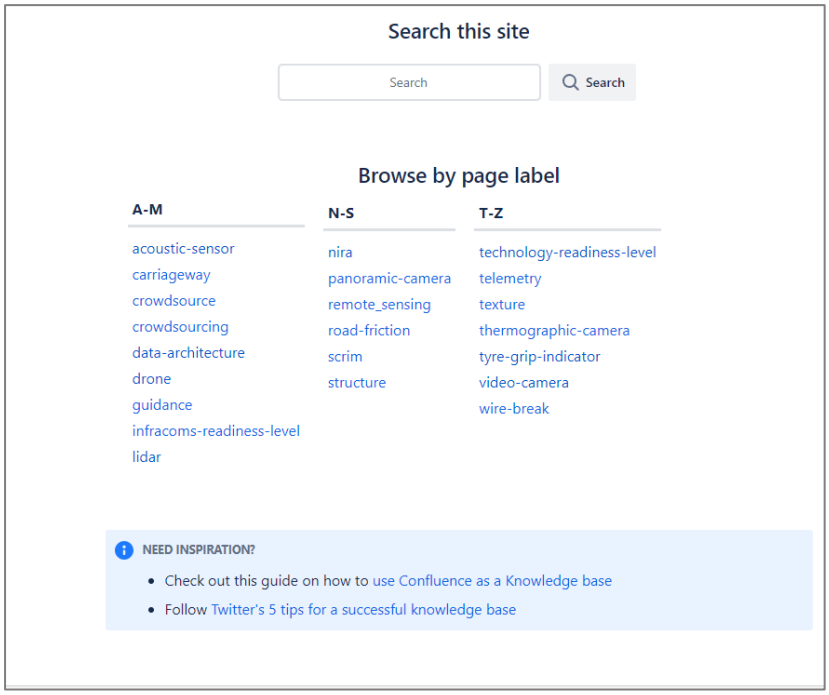


Figure 7. Access the home page



Search this site: Type any text into the search box, and click Search, to bring up any page in the site containing the search text

Browse by page label: Click on any of the page labels listed to bring up any page in this site containing that label. The page labels in this list are automatically populated by the toolkit based on page labels assigned to the page.

Figure 8. Search and browse functions

3.1.2 Add to the Knowledge Base

The Knowledge Base is implemented as a series of Pages in the toolkit. Any user with appropriate permissions can add to, review or comment on the Knowledge Base in the same way as they can interact with any Page in Confluence. See Chapter 4 for more information on general wiki functions.

3.2 Technology Appraisals

A technology appraisal is a detailed review of a particular application of a technology by an NRA.

As described in Deliverable D2.1 Appraisal Methodology, an INFRACOMS appraisal has three (3) core processes, with increasing levels of detail and complexity. See Figure 9. These three processes are:

- Pre-Evaluation
- Evaluation
- Case Study

The toolkit allows the storage of information relating to each stage of the appraisal methodology.

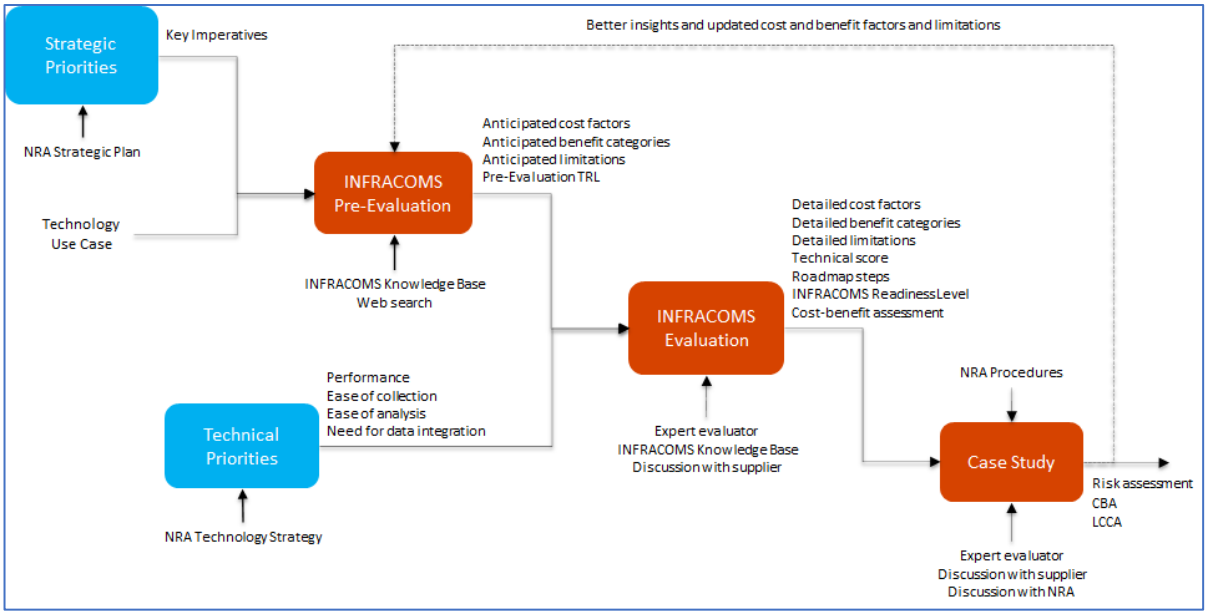


Figure 9. INFRACOMS Appraisal Methodology

3.2.1 Explore the list of technology appraisals in the toolkit

From any point in the toolkit, click INFRACOMS technology appraisals on the Side Menu Bar (Figure 10) to navigate to the list of appraisals and to bring up the Technology Appraisals screen (Figure 11).

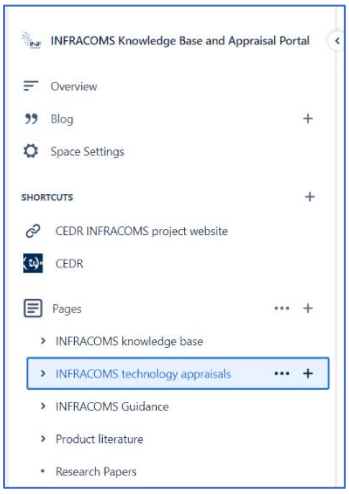


Figure 10. Navigate to the INRACOMS technology appraisals

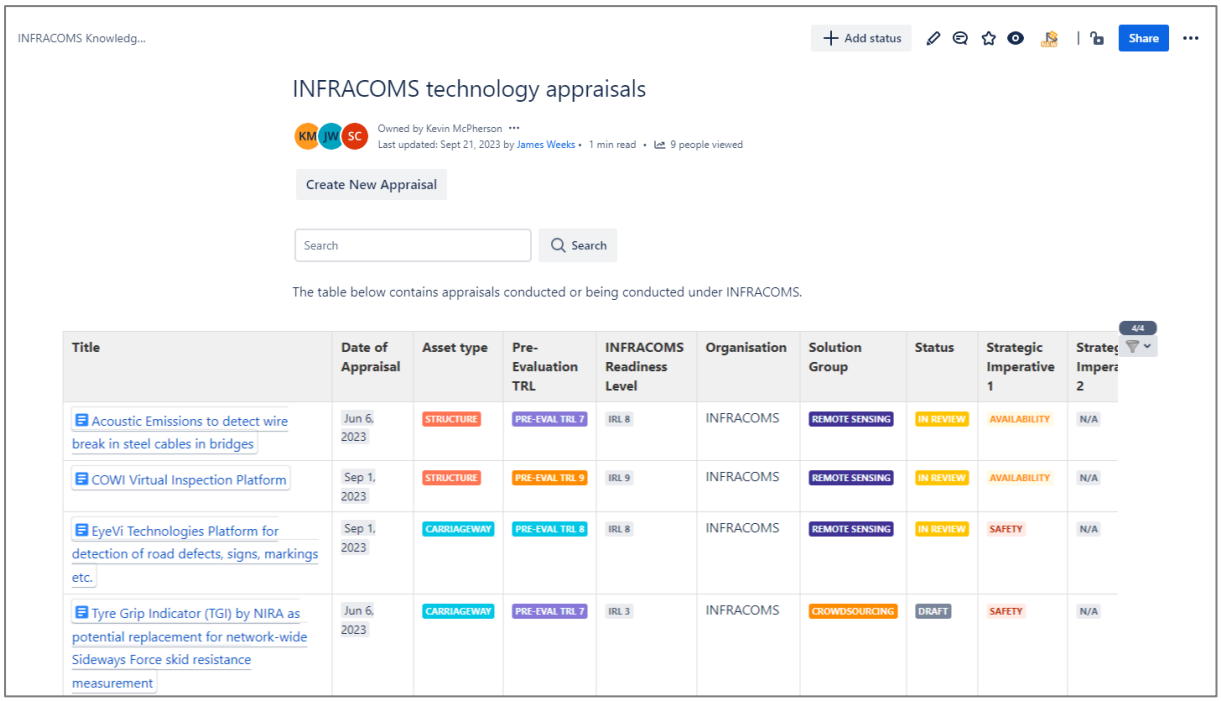


Figure 11. INFRACOMS Technology Appraisals

The page contains a list of all appraisals in the database. This list is populated automatically in the toolkit and is updated whenever a new appraisal is added. See section 3.2.2 for how to add a new appraisal.

The user can search for a particular use case by typing text into the Search box.

A filtering mechanism is also built into the tool so that the user can filter the list of use cases. Click the small filter button at the top right hand corned of the list of use cases in Figure 11, or click any of the headings in the table to filter by a particular column (for example, see Figure 12 which restricts the list to technology use cases applicable to the carriageway asset type). Multiple filters can be set and applied.

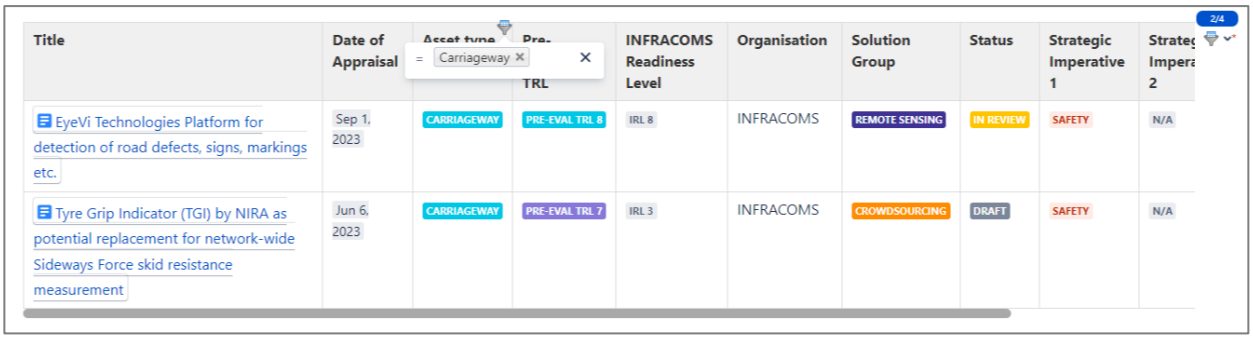


Figure 12. Filter the INFRACOMS list of appraisals

3.2.2 Add a new appraisal

To add a new appraisal, click on the grey 'Create New Appraisal' button near the top of the appraisals screen. See Figure 11.

Figure 13. Create new INFRACOMS appraisal button

This creates a new blank page in the toolkit based on the INFRACOMS appraisal template. See Figure 14. All boxes in the template are designed to store information on the Pre-Evaluation, Evaluation or Case Study.

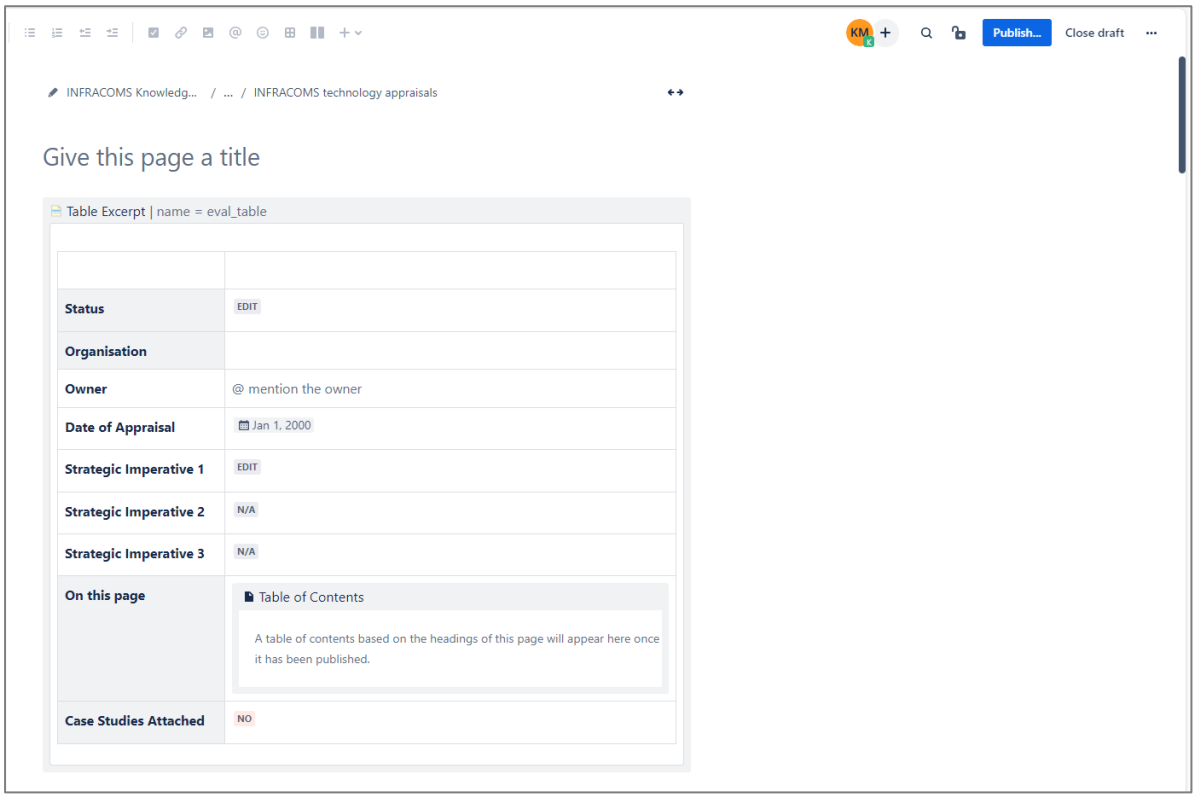


Figure 14. Create new INFRACOMS appraisal using the template

It is important to give the new appraisal a title. This title should be descriptive of the use case of the technology. You can 'publish' or save this page at any time, and it will appear in the list of appraisals as shown in Figure 11.

The first set of information in the table (marked 'Table Excerpt' in Figure 14 is general information concerning the status, the owner, the organisation, the date of appraisal, and the strategic imperative(s) of the NRA for which this technology is under consideration. Any information which appears in a 'table excerpt' is included automatically in the the search and filter criteria in Figure 11.

By default, the Status field is blank. The Status field should be set to either Draft, In Review or Completed depending upon its status. If the appraisal status has been reviewed, the reviewer (who should be a member of the user group 'INFRACOMS managers') should set the value of this field to 'Completed' and set the Page Restrictions so that only INFRACOMS managers can view and edit. See Figure 20.

Figure 15. Set the status field and restrict editing to complete an appraisal

Pre-Evaluation provides a high-level description of the technology, analysis of the anticipated cost factors, benefits and limitations of the technology use case. The Pre-Evaluation section of the template allows the appraiser to fill in all the information included in the Pre-Evaluation. See

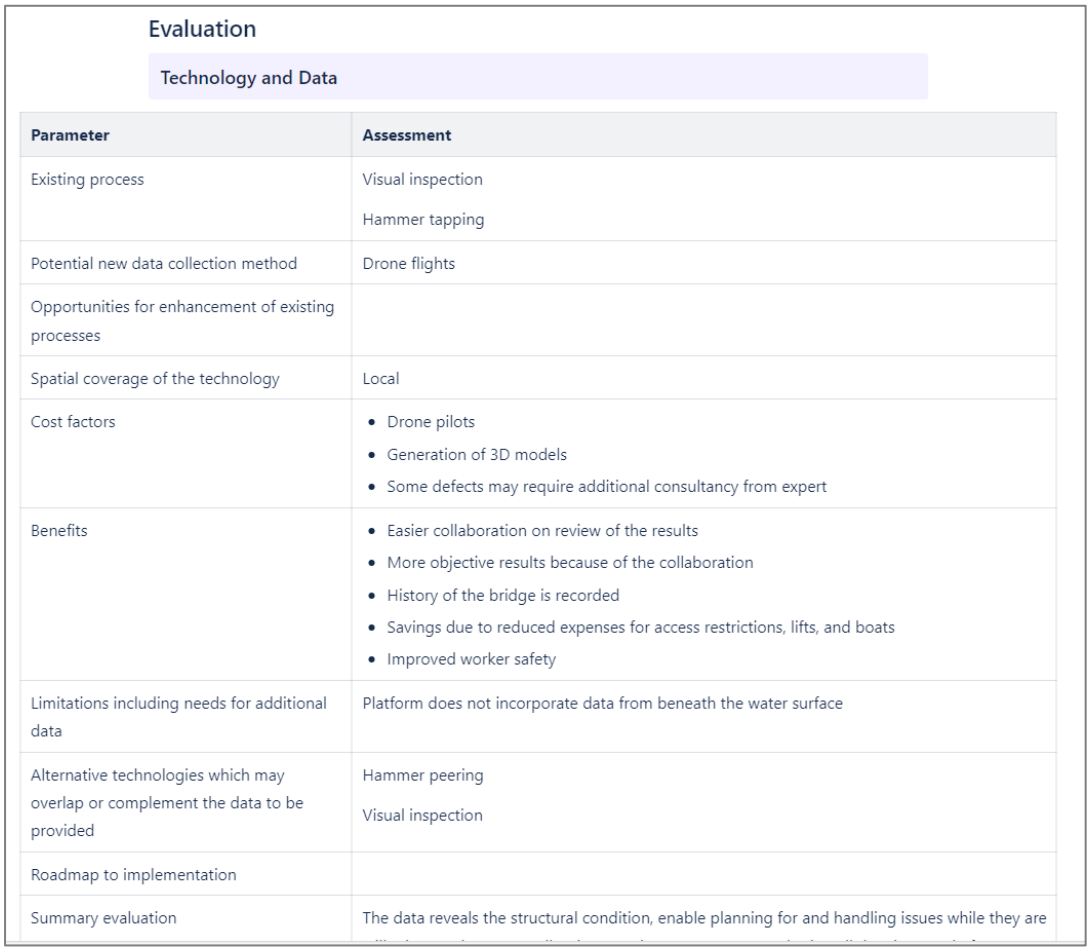
Figure 15. See also D2.1 INFRACOMS Appraisal Methodology for purpose and details of each field.

Pre-Evaluation

Parameter	Assessment
Asset type	STRUCTURE
Solution group	REMOTE SENSING
References	https://www.cowi.com/focus/virtual-inspection
Performance indicators	Surface condition (delamination, cracks)
Anticipated cost factors	• Drone scan of structure • Software cost and cloud access • Expert evaluation may also be required
Anticipated benefits	• Inspections using drones on large bridges can significantly reduce the need for lifts, boats, climbing, and rappelling equipment. • Drones with thermography camera provide greater possibility to collect data from the entire structure than hammer tapping, which often only collect data from selected random samples. • Direct coupling between photos and geographical position facilitate tracking the development of defects at later stages. • Capability to track defect progression over time is enabled by comparing current issues with images captured from prior years.
Anticipated limitations	• Some areas may be inaccessible with drones • Platform does not encompass data from beneath the water surface
Pre-Evaluation TRL	PRE-EVAL TRL 9

Figure 16. Pre-Evaluation portion of the INFRACOMS Appraisal

The Evaluation represents a more detailed breakdown of the, benefits, limitations and cost factors of the technology within the proposed use case, including a more in-depth technical evaluation and an assessment of the steps needed that would be required to implement it in an NRA. It provides an assessment of the readiness level of the technlogy from the NRA's perspective. The Evaluation section of the template allows the appraiser to fill in all the information included in the Evaluation. See Figure 17. See also D2.1 INFRACOMS Appraisal Methodology for purpose and details of each field.



Evaluation

Technology and Data

Parameter	Assessment
Existing process	Visual inspection Hammer tapping
Potential new data collection method	Drone flights
Opportunities for enhancement of existing processes	
Spatial coverage of the technology	Local
Cost factors	• Drone pilots • Generation of 3D models • Some defects may require additional consultancy from expert
Benefits	• Easier collaboration on review of the results • More objective results because of the collaboration • History of the bridge is recorded • Savings due to reduced expenses for access restrictions, lifts, and boats • Improved worker safety
Limitations including needs for additional data	Platform does not incorporate data from beneath the water surface
Alternative technologies which may overlap or complement the data to be provided	Hammer peering Visual inspection
Roadmap to implementation	
Summary evaluation	The data reveals the structural condition, enable planning for and handling issues while they are

Figure 17. Evaluation portion of the INFRACOMS Appraisal

3.3 Case Studies

A Case Study is an in-depth analysis of a completed implementation of the technology for a given NRA. Due to the detailed nature of each technology and use case, and the fact that case studies for different technologies may be very different in content, the INFRACOMS Appraisal Toolkit allows storage of the Case Study information as a PDF (Portable Document Fomat) file. Typing a '/' in the table brings up a menu in the toolkit which allows the user to add an image, video or file to the site. Figure 18 shows how to upload a PDF file as a case study. Multiple PDFs can be added to represent different case studies.

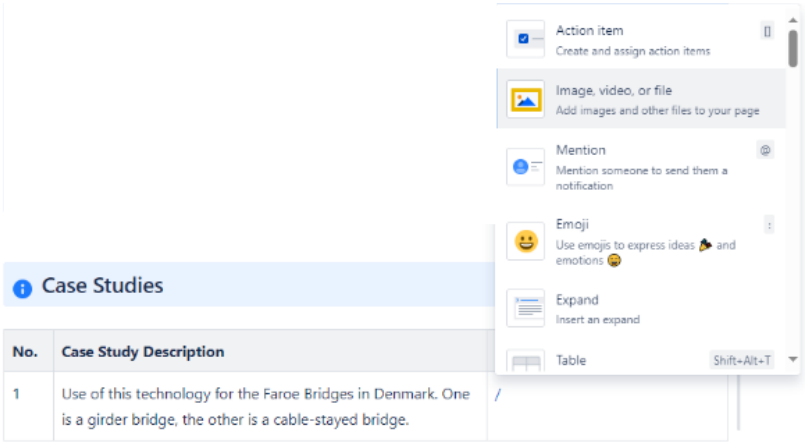


Figure 18. Uploading a PDF file as a case study

After uploading a case study, the user should also update the 'case studies attached' field in the appraisal header to 'Yes'. See Figure 19.

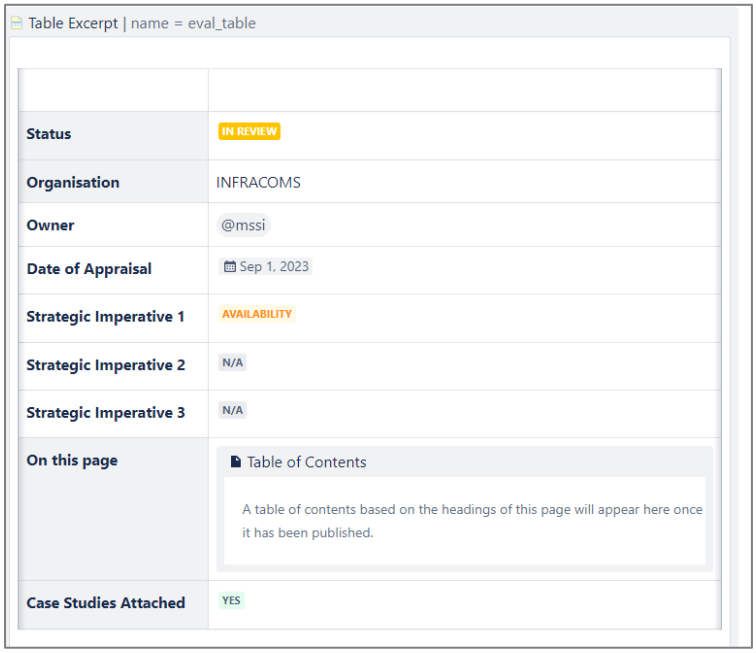


Figure 19. Mark the appraisal to indicate that a case study is attached

4 Standard Wiki Functions

Most of the pages in the INFRACOMS Appraisal Toolkit have multiple standard functions, whether part of the Knowledge Base, or Technology Appraisals, or Guidance, or Literature. This chapter describes some of those standard functions. Further information is available in Confluence online documentation.

Edit

In normal mode, pages can be viewed or commented upon. To edit the contents of any page, click the edit button at the top of the page to go to edit mode. This allows you to edit the page using standard edit functions. See Figure 20.

Figure 20. Edit page

Update changes

If in edit mode, you may make changes to the page. When complete, you may update the page changes (see Figure 21), or close the page without saving the updates (click the Close button immediately to the right of the Update button.

Figure 21. Update page

Comment

There are two ways to add comments to a page:

1. Comments section: Scroll to the end of a page to find the comments section.
2. Inline comments: Highlight a portion of text on a page and the comment button appears. Use the comment button at the top of a page to display any inline comments.

Figure 22. Adding comments to a page

Watch

Users can elect to receive notifications via email when pages they are "Watching" are updated. Emails are sent instantly (or every 10 minutes) as changes are made and so notifications can quickly become intrusive. To stop receiving notifications the user can stop "Watching" a page. This may be done in multiple ways:

1. Using the eye icon on a page:

Figure 23. Watch or stop watching a page

2. Going to their user settings: *User icon (furthest top-right) > Settings > Watches*
3. Using the link at the bottom of an email notification:

4. Admins have the option to manage who watches a page or space via the eye icon on a page:

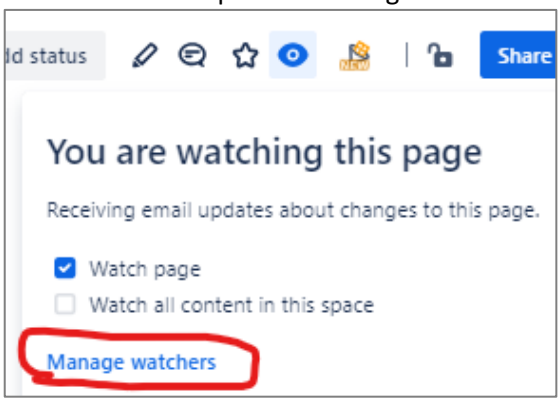


Figure 24. Manage watchers on a page

Users will automatically become watchers of a page when they edit or comment on it. This behaviour may be changed by the user via their email settings:

User icon (furthest top-right) > Settings > Email > Autowatch.

Page labels

One of the key features of the toolkit is the ability to label pages. By assigning labels to pages, users can categorise and organise content, making it easier to find later.

Adding labels to your pages is easy and there are many ways to do it. The most straight-forward way is simply clicking the label icon at the bottom of any page in to bring up the label box, and type in the label you want. All labels are convered to lower case, and if multiple words are used, then these are automatically hyphenated. See Figure 25.

Figure 25. Adding a label to a page

Labels come with the risk of label overload. That's why it's important to follow some best practices when using labels. The top three recommendations when using labels are:

Use Labels to Categorize Pages: First and foremost, the aim of using labels is to bring additional categories to your content, so that you can easily find all pages in a specific category. For example, you could use the label ‘structures’, so that you can later list all technologies related to structures, no matter where in the knowledge base it is located.

Be Consistent: It's important to keep your labels organized and be consistent. You can do this by using a naming convention for your labels. For example, a frequent source of label confusion is the question whether to use dashes or underscores in compound words, i.e. whether your team prefers meeting_notes or meeting-notes. In INFRACOMS, we have used dashes. Note that Confluence ignores capitalization and displays all labels in lowercase. That means How-To and how-to are the same label as far as Confluence is concerned.

Be Clear, Concise and Specific. Great labels are clear, concise and can be quickly understood without much context. Try to keep your labels short (1-2 words) so they're easy to scan. It's also important that your labels are specific. Don't be vague: and label a page 'general' or 'stuff' if those labels do not carry any clear meaning; those labels aren't going to be very helpful. Finally, be sure to remove any labels that do not describe or categorize a page.

Page history

Confluence keeps a history of changes to all pages. Click the ellipsis (…) at the top right hand corner of the page (see Figure 26) and click on Page history to view previous versions of the page and to identify what changes were made, by whom, and when. Previous verions of pages can be restored as necessary, or compared with other selected versions. Other functions such as Change page owner are also available.

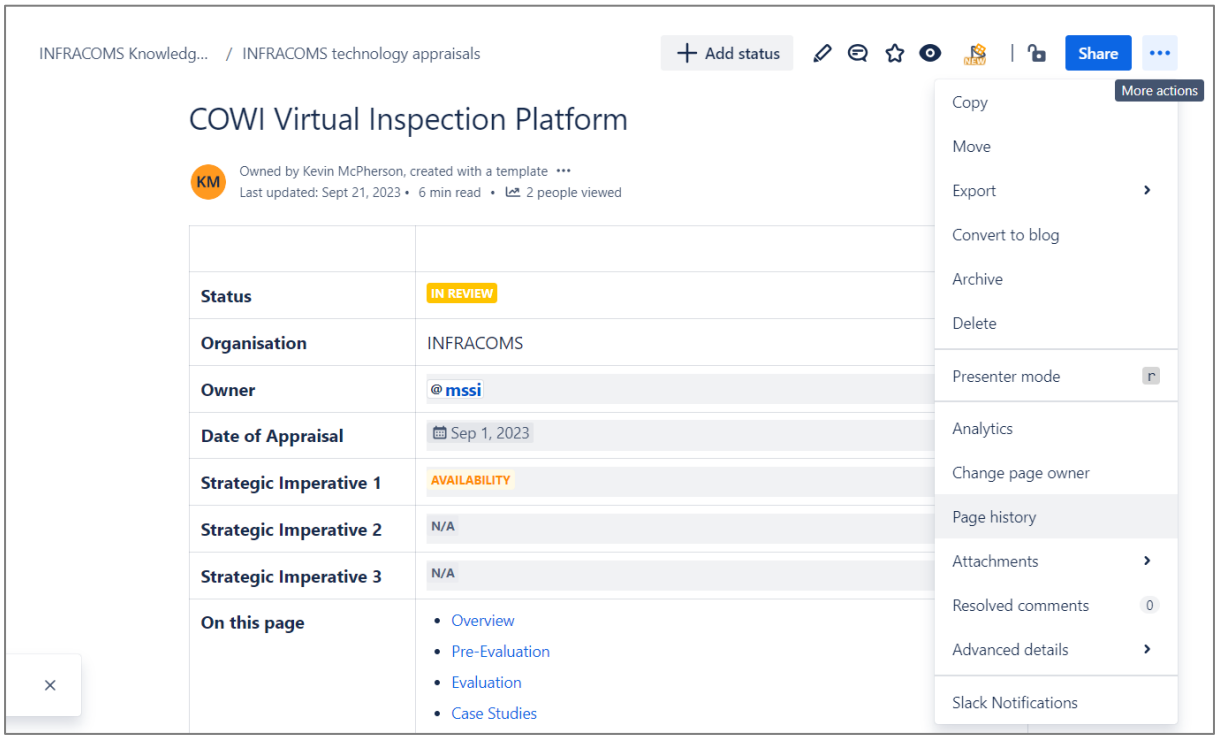


Figure 26. History of changes to a page

Page restrictions

Restrictions may be set on individual to restrict users or groups from editing them. Configure this on each page through the padlock icon. See Figure 27.

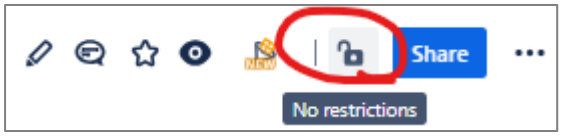


Figure 27. Setting restrictions on a page

Child pages inherit restrictions from their parent page.

Site or Space admins can view and remove restrictions via *Space Settings > Manage pages > Restricted*.

5 Security and Administration

The toolkit has been configured for use by staff on the INFRACOMS project to conduct technology appraisals, upload case studies, and generally add information to the knowledge base. This chapter provides basic information on how user groups have been established in Confluence for purposes of INFRACOMS, how new users can be added, and how users and user groups could be set up to enable NRA usage of the toolkit. This chapter is intended for use by a system administrator. Further detailed information can be obtained from the Atlassian site and other online resources.

5.1 Adding users

To add a new user to Confluence, the Systems Administrator should click on Teams at the top of any site page, and click 'Invite people to Confluence'. See Figure 28. Add an email address for the person you wish to invite. More than one email address can be added. Confluence will send an email to any email address inviting them to the site.

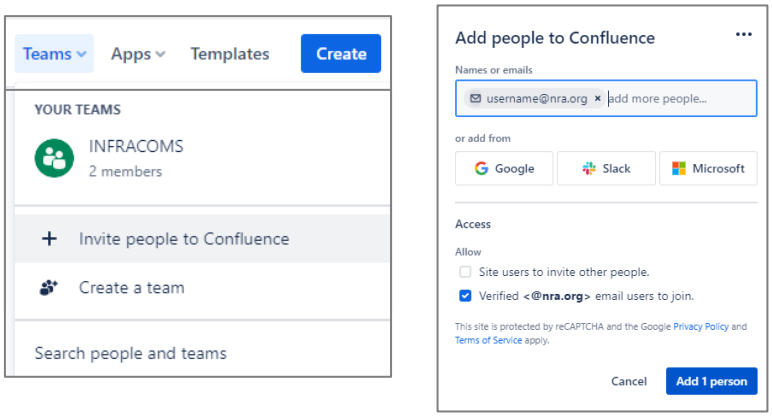


Figure 28. Add users to Confluence

Note that granting any user access to the INFRACOMS toolkit has financial implications for the hosting organisation. The system administrator should check with INFRACOMS project management before adding users.

5.2 INFRACOMS User Groups

User groups are a method for assigning permissions to multiple users.

The following groups have been created for the INFRACOMS project:

- "site-admins": This represents the highest level of access. Members of this group can access all admin features including creating users, assigning permissions, removing users, and billing.
- "confluence-users-infracom-cerl" group: regular "User" role access to the Confluence product and the toolkit. Members of this group can view and edit all pages in the INFRACOMS Knowledge Base and Appraisal Portal. However, they cannot configure page restrictions (for approving an appraisal).
- "INFRACOMS Managers" group: Members of this group can do everything that a regular user can do, plus can configure page restrictions in order to approve an appraisal.

5.3 NRA User Groups

If an NRA wishes to obtain access to the INFRACOMS toolkit while the project is ongoing, then a separate User Group should be created to represent that NRA, and individual NRA staff members can be created as members of that User Group.

If required, members of this group can create appraisals in their own Space. If they wish to share these appraisals to other INFRACOMS users, then a member of the INFRACOMS user group can copy the completed appraisal pages to the INFRACOMS space.

5.4 NRA Separate Instance

If an NRA wishes to obtain create a separate site for internal use by the NRA only, then the NRA becomes responsible for all administration and billing for that site. The NRA could replicate the groups set up for INFRACOMS, or could create an entirely different security model.

6 Platform

The INFRACOMS toolkit has been created using the Confluence platform. Confluence is a wiki solution that is part of the Atlassian suite of products. Atlassian provides extensive guidance on administration and setup of Confluence, including web pages, YouTube tutorials etc. This chapter provides basic information on how Confluence has been set up for purposes of INFRACOMS, and is intended for use by a system administrator. Further detailed information can be obtained from the Atlassian site and other online resources.

6.1 Confluence site

The name of the Confluence site created for INFRACOMS is "infracom-cerl". Site admins can manage configuration of user roles, apps/macros and billing/licensing at an overall site level. A site can consist of multiple users, Teams, and Spaces.

6.2 Site and space migration

If required, for example to export the INFRACOMS site for sole administration and use by an NRA, the Confluence site administrator can export the entire INFRACOMS site to another instance of Confluence. See the Atlassian guide for migration of a site. For migrating a space see this Atlassian guide on exporting and importing spaces.

Page templates are not included in the above types of transfer. Templates may need to be remade in the target instance of Confluence. To remake a template, this workaround may be useful.

6.3 Teams

In Confluence, Teams can be set up so that users of that team can be @mentioned or have content shared with them by referencing the Team instead of multiple users separately. Note that permissions are **not** applied to Teams, use Groups to configure permissions.

6.4 Spaces

In Confluence, Spaces are containers for content such as Pages, Blogs or Files. The *INFRACOMS Knowledge Base and Appraisal Portal* is implemented in a single Space.

Users can also have their own Personal Space. By default, these are created automatically when new users are added.

6.5 Pages

Each technology appraisal exists as a Page. Pages can be nested to create hierarchies of content. Nested pages become *Child pages* to the *Parent page* and inherit properties from the parent.

Child Pages may be created by dragging and dropping the page in the sidebar menu or clicking the "+" icon next to the target parent Page. Technology appraisals created from the button on the technology appraisals summary page have been configured to become child pages of that page automatically.

6.6 Templates

Pages can be created from **templates** to encourage consistency. A global template for technology appraisals has been created and is triggered from a button on the INFRACOMS technology appraisals landing page.

Only **site admins** can create or edit global templates.

6.7 Apps/Macros

Apps and macros extend and improve functionality and create dynamic content. For example, the summary table on the technical appraisals landing page is achieved through macros on both the landing page and each tech appraisal page that lookup and transform the relevant content.

Third party macros can involve licensing with an associated additional cost per user/month. The "Handy" macros are an example of this in use on the tech appraisals pages.

The *Handy Status* macro has been used in the toolkit to enable creation of single-value statuses that the user may select from preconfigured sets of values e.g. the "Solution group" status on each tech appraisal page. Users may update a status without putting a page in edit mode. Status sets may be configured by **site admins** via *Apps > Handy Macros*. See Figure 29.

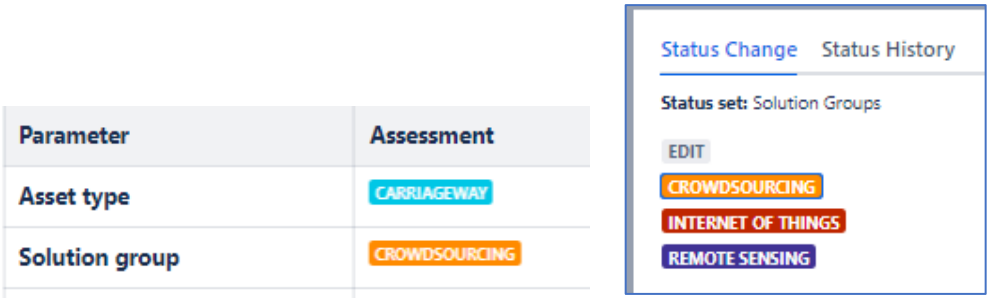


Figure 29. Handy macros

The Table Transformer macro is used to transform summary information from each tech appraisal page and display the summary table on the tech appraisal summary page. Custom transformations and formatting are possible using SQL. See this Advanced table cells formatting guide for formatting examples.

6.8 Acceptable use

All collaborative spaces should have an acceptable use policy so that users understand the purpose of the site and the rules governing the moderation and administration of the site. A basic acceptable use policy has been established for INFRACOMS. This should be reviewed and extended in future as more users and organisations are granted access.

6.9 Site moderation

All collaborative spaces require moderation to ensure that the acceptable use policy is being adhered to. A basic moderation policy has been established for INFRACOMS. This should be reviewed and extended in future as more users and organisations are granted access.

7 Index