SIX Sustainable Industry X

MOBILE WORK MACHINES

Playbook for RDI Infrastructure-Industry Collaboration

Best practices and recommendations to streamline infra-industry research, development and innovation collaboration

Contents

KEY CONTENTS SUMMARIZED

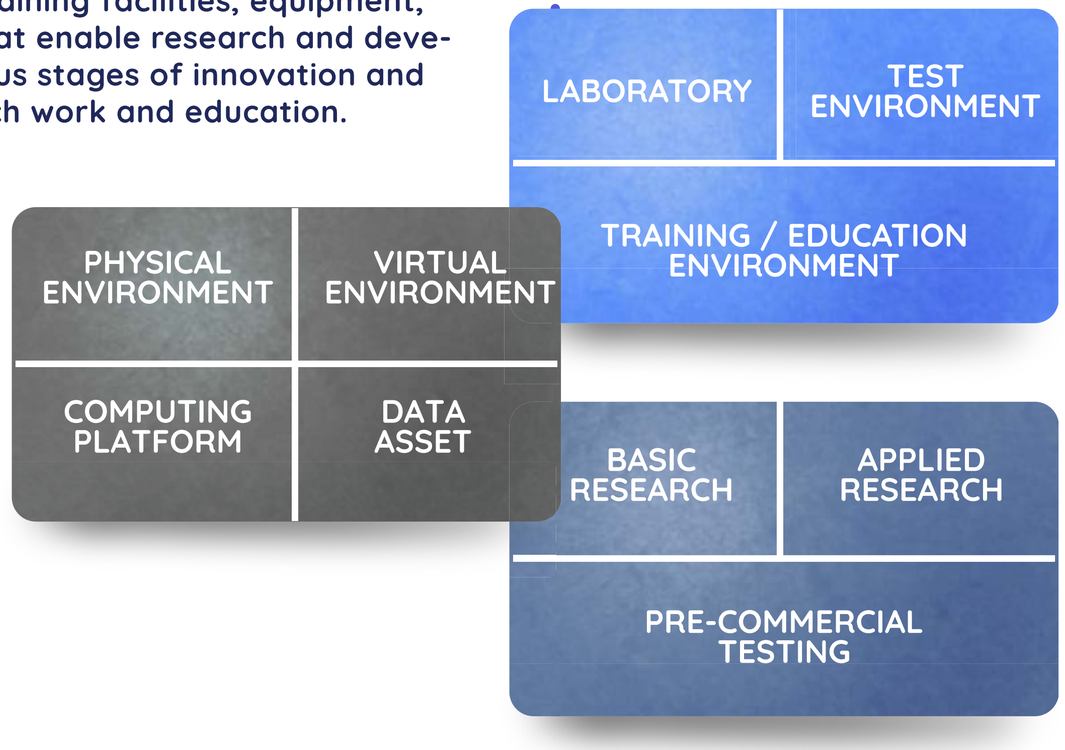
The key contents of the playbook are summarized on these first pages of the playbook. You can read more about the topics in the playbook – by clicking on the headings, you can jump directly to the topic you want.

INFRASTRUCTURE

Infrastructure refers to different kinds of research, development, testing, and training facilities, equipment, materials, and services that enable research and development activities in various stages of innovation and support organized research work and education.

Infras can be categorized in multiple ways, such as:

p. 13



KEY POINTS TO AGREE BEFORE COLLABORATION

p. 20

☑ CHECK LIST

Before making the order agreement

- ☐ Defining customer needs and infra capabilities, and ensuring those are compatible
- ☐ Other 'deal-breakers' – which requirements have to be met?

In the agreement

- ☐ Confidentiality, security, ownership of the results:
  - NDA agreements
  - IPR, including who owns the results, and other legal and commercial terms
  - Sharing the data
  - Security issues
  - Access permits
- ☐ Safety related aspects:
  - Responsibilities related to
    - Facility and equipment safety
    - Human safety
  - Procedures related to working alone/in collaboration
- ☐ Project / Task management related aspects:
  - Roles and responsibilities, including project manager and contact persons
  - Project/task planning and schedule
  - Pricing, invoicing posts
  - Acceptance criteria for results

BEST PRACTICES FOR INFRA – INDUSTRY COLLABORATION p. 16

PROJECT / TASK MANAGEMENT

- Plan in advance and prepare well for the project/task
- Include the infrastructure personnel already early on in planning
- Reserve enough time, money and other resources for the project/task
- Acquire the ability to prepare for and respond to exceptional situations
- Define clearly the company's requirements for the project/task and make sure they align with infra's capabilities

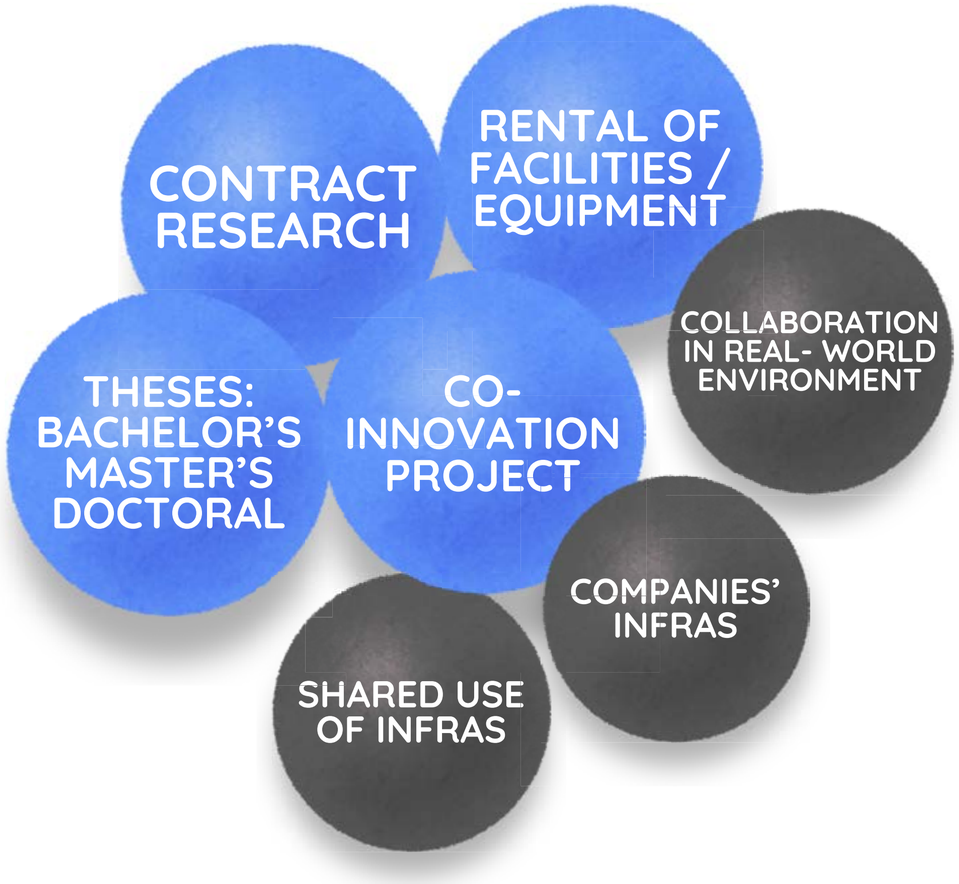
COLLABORATION

- Define roles and responsibilities of both parties involved
- Identify the owners of the project/task from both parties
- Ensure direct communication between the operational teams involved
- Grant the operational teams mandate to handle tasks independently
- Be active in the collaboration and facilitate ongoing dialogue
- Make the effort to get to know and understand the other party's needs and capabilities
- Share data with others whenever it is possible

INFRA COMPETENCIES AND MANAGEMENT

- Ensure that necessary support functions are available in the infra
- Assure accumulation of expertise and continuity in the infra
- Appoint a responsible person for the infra with a visibility over the whole infra

COLLABORATION MODELS



INFRA SERVICE DESCRIPTION ELEMENTS p. 30

ESSENTIAL ELEMENTS

- Infra’s name, home organization, and location
- Up-to-date contact person
- Operational overview of the infra
- Infra’s capabilities
  - At least overview of capabilities should be described
  - Accurate main specifications of the infra should be at least readily available, including e.g. performance criteria, control system interfaces and standards
  - Certificates and accreditation, if available
- Service models and collaboration models available in the infrastructure
- Basic pricing when applicable
- Short description of practices related to
  - safety
  - security, level of confidentiality
  - legal and commercial terms

RECOMMENDED ELEMENTS

- Case examples of previous infra
- Utilization and references
- Links to public results
- Pictures and videos of infra and its usage
- Preparation time required
- Highlighting the researchers

INFORMATION SHOULD ALWAYS BE KEPT UP TO DATE

Building mutual understanding p. 34

Key aspects to understand about RDI infras

- All RDI infras have their specific strengths and they can provide solutions to different kinds of needs and requirements
- KPI's differ between infras

For example:

Universities and universities of applied sciences

- have generating research and teaching as their primary focus
- have evolving infra that requires ongoing development
- Universities often have limited permanent staff

Commercial RDI infrastructure operators

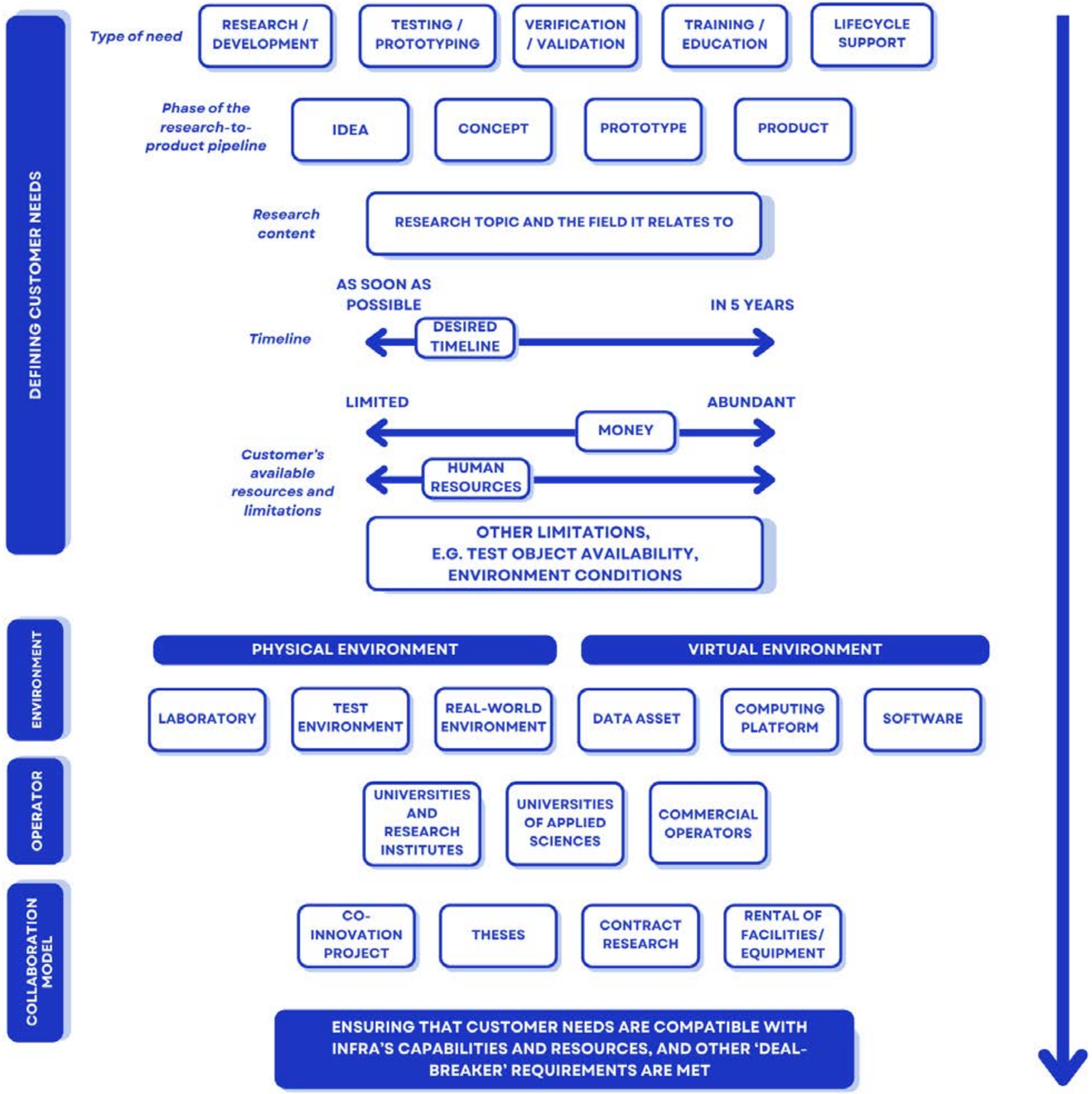
- have serving companies as their core business
- handle customer requests with full confidentiality – customer has the responsibility for arranging potential collaboration with infra's other customers to utilize synergies

Key aspects to understand about companies

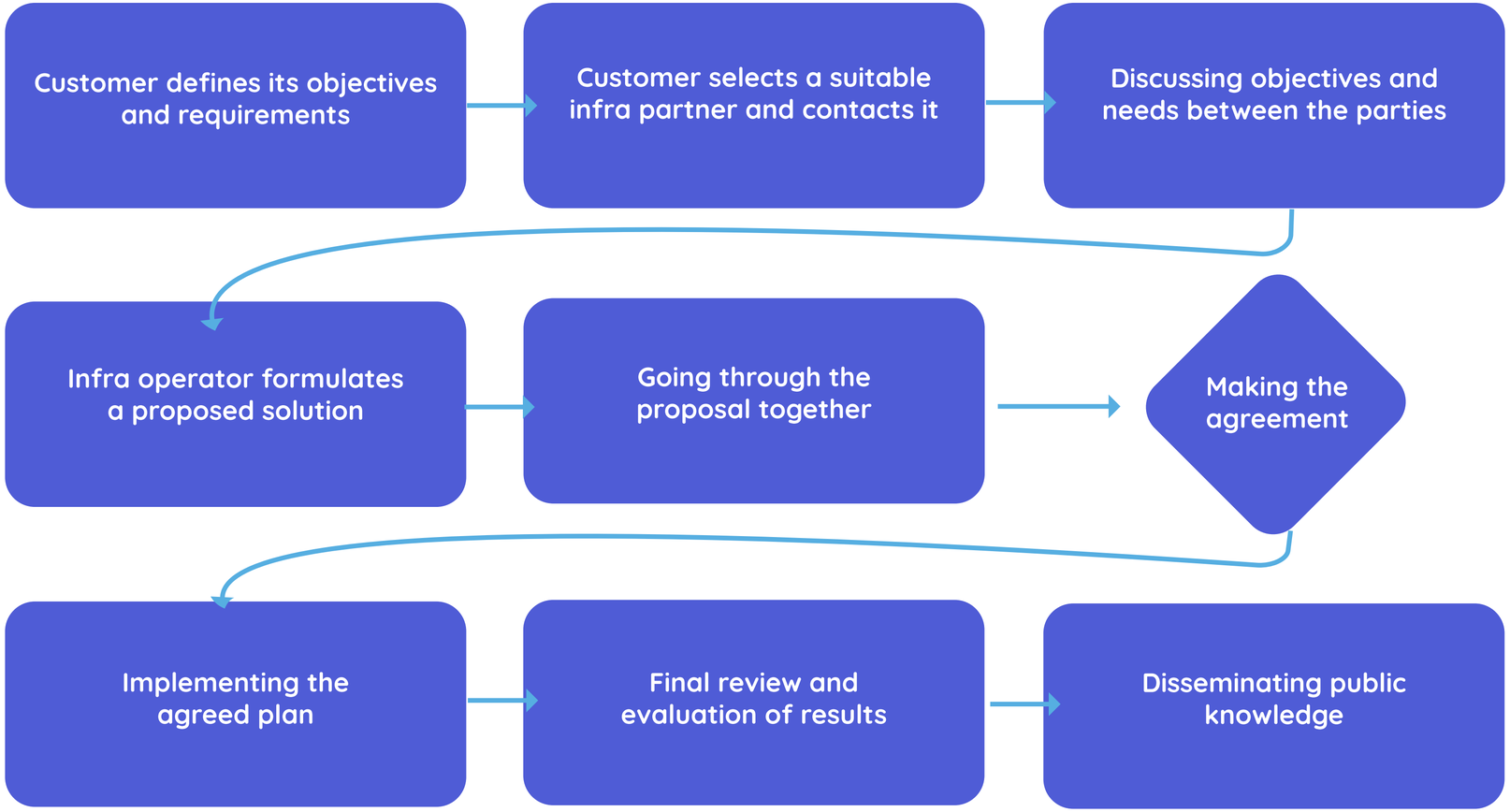
- Companies are result-oriented which creates a need for efficient and precise project/task management
- How and when the findings of public projects are disseminated make a difference for the company
- The spectrum of companies' infra needs is broad
- The size and the maturity of the company influence its operating practices, needs and available resources

Key aspects to consider when selecting an RDI infra partner

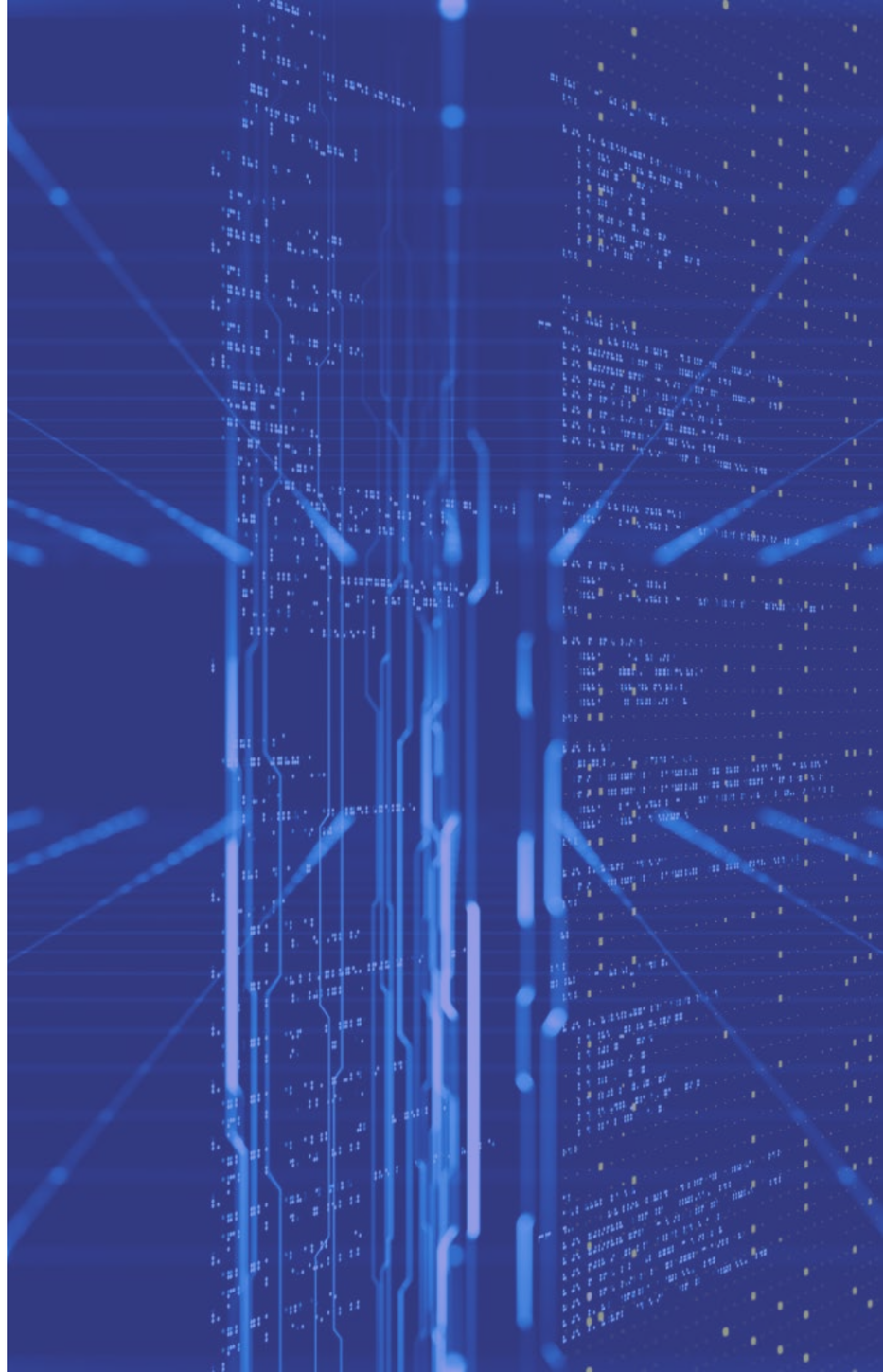
p. 39



Typical RDI infra utilization process p. 42



1. Introduction



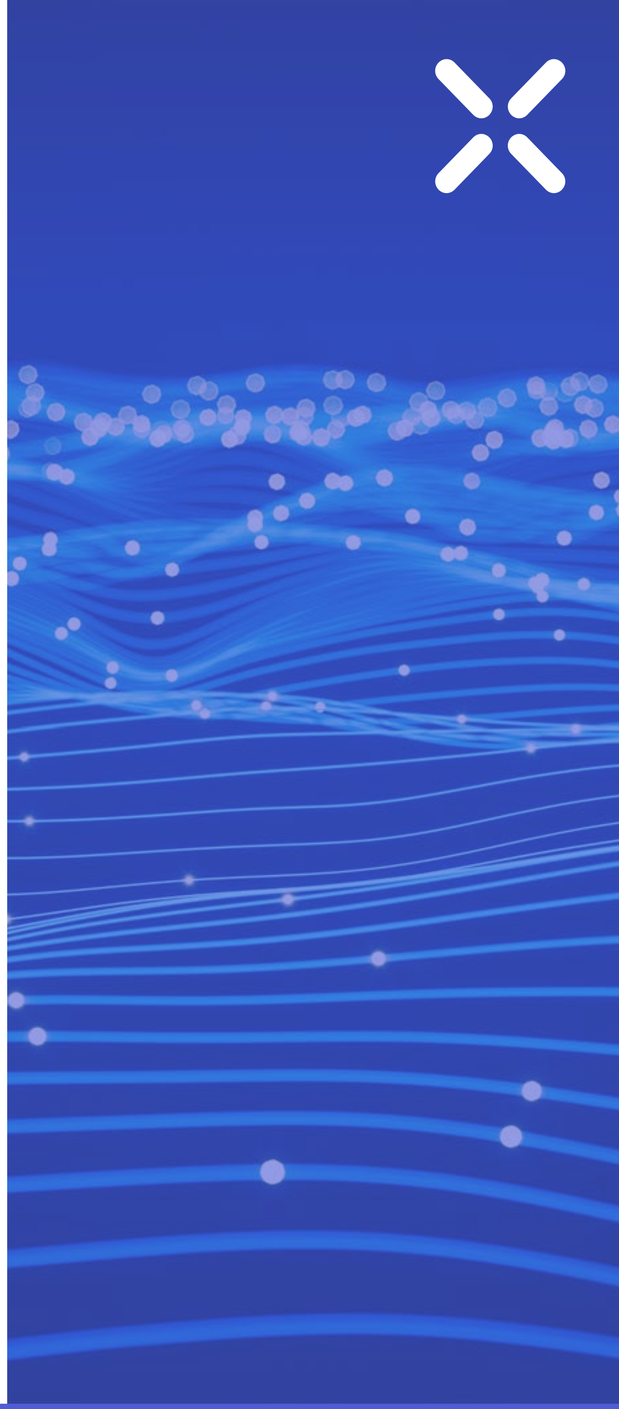
1. Introduction

In Finland, there is a large number of research, development and innovation infrastructures with versatile possibilities to serve as platforms for researching, learning and developing ideas and products further.

It has been recognized that those who could potentially utilize the infras have had difficulties finding and accessing them. There is a common will to improve the situation: infrastructures seek to raise their utilization rates, while companies are interested in utilizing existing infras more effectively in their operations.

In August 2025, Technology Industries of Finland in collaboration with SIX Mobile Work Machines cluster published Finland's National Mobile Machine Growth Strategy 2035, which sets ambitious goals for the mobile machine industry for the following ten years: tripling the industry revenue, creating about 45.000 new jobs and having Finland recognized as a leading R&D player globally.

The strategy highlights the importance of RDI infrastructures, as developing and expanding joint infrastructure and strengthening research-industry collaboration are included in the key actions to achieve the goals set in the strategy. Infrastructures and infrastructure-industry collaboration have an essential role in reaching the desired future visions.



As collaboration between companies and RDI infrastructures is critical for reaching the set objectives, the aim is to increase and develop the collaboration even further. Both parties benefit from the collaboration in multiple ways, such as:

- **Generating opportunities to boost infras' utilization rates:** Active collaboration can lead to increased infra utilization. Increased utilization rate creates more income that can be reinvested, for example, in developing the infras which then creates new possibilities also for the companies utilizing them.
- **Decreasing the need to invest in new infra:** Utilizing existing infras give companies a quicker and less expensive way to innovate, develop and research than investing in and building new infras for their own use.
- **Accelerating innovation:** Collaboration can accelerate both business-driven and research-driven innovation as active collaboration can improve the capabilities of both parties. It also increases the level of technology transfer between the parties.
- **Enhancing communication and mutual understanding:** When infras are used as collaboration platforms parties learn from each other and about each other. That helps to ensure, for example, that infras' capabilities and services are relevant to the industry and that research naturally builds on previous results to accumulate knowledge.

The playbook aims to support collaboration between companies and RDI infrastructures by collecting best practices and lessons learned into one document.

The playbook was created by SIX Mobile Work Machines cluster in collaboration with multiple research and testing organizations and infrastructures: representatives from Autonomy & Mobility Lab of Aalto University, Eurofins Expert Services Oy, LUT University, Automotive Testing Chamber of Metropolia University of Applied Sciences, NUVE-LAB of Oulu University of Applied Sciences, Innovative Hydraulics and Automation (IHA) Laboratory of Tampere University, Autonomous and Intelligent Systems (AIS) Laboratory of Turku University of Applied Sciences, University of Oulu with OuluZone+ and VTT Technical Research Center of Finland participated in the playbook work. The companies who participated in the playbook work included IONCOR Oy, Kalmar Oyj, Nokia Oyj, Normet Oy, Ponsse Oyj and Sandvik Mining and Construction Oy (p. 51).

The contents of the playbook were gathered based on two joint workshops and one-on-one discussions with participating organizations to collect their practical insights and learnings about the topic.

The playbook consists of chapters discussing principles of RDI infra-industry collaboration, how accessibility and visibility of infras and their services could be improved, key aspects of infras and companies as collaboration partners and typical process in collaboration from selecting a suitable infra partner to infra utilization.

At the end of the playbook, a few case examples of infra-industry collaboration are described. The key contents of the playbook are summarized in the first pages of the playbook.

Definitions

Infrastructure

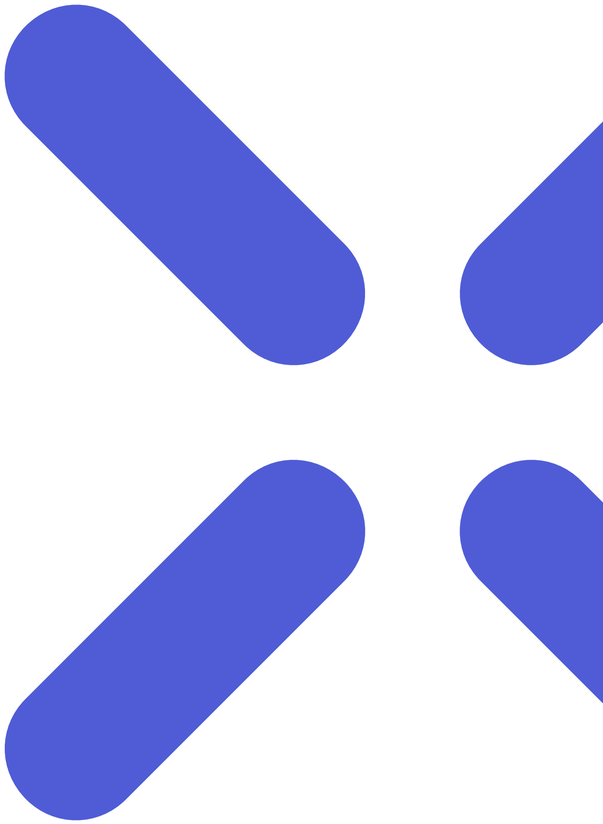
Infrastructure refers to different kinds of research, development, testing and training facilities, equipment, materials and services that enable research and development activities in various stages of innovation and support organized research work and education.

Infrastructures can be categorized in multiple ways, such as

- Physical environment vs. virtual environment vs. computing platform vs. data assets based on the infra's operating principle
- Laboratory vs. test environment vs. training and education environment based on the infra's intended use
- Basic research vs. applied research and development vs. pre-commercial testing based on which different phases of research-to-product pipeline the infra can be utilized for

Playbook

A playbook is a documentation of jointly agreed procedures, guidelines and best practices. It is not a formal, authoritative document, but rather a guide consisting of lessons learned and recommendations to make collaboration between parties smoother. It aims to gather a realistic entity consisting of elements that all parties can commit to.



Infrastructure

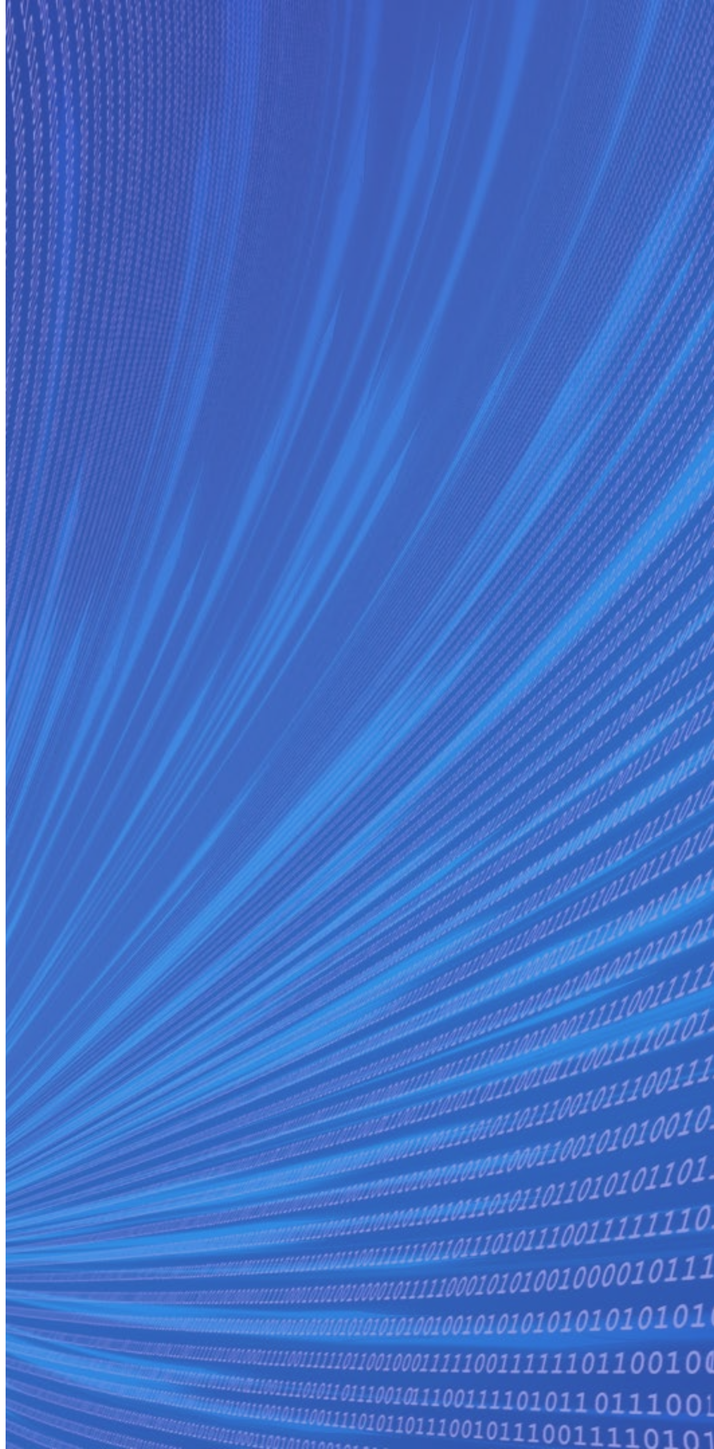
Research and technology infrastructures - definitions by European Union

In the European Union's infrastructure strategy published in September 2025, Europe's research and technology infrastructures are presented as essential for scientific progress, innovation and industrial competitiveness. Research and technology infrastructures rely on fragmented financing from regional, national and EU sources, often lacking long-term sustainability. Better coordination is needed to ensure stable support and maximize the impact of investments. In the strategy, infrastructures are divided into two categories, research and technology infrastructures.

Research infrastructures are equipment or set of instruments, collections, archives and scientific data infrastructures directed for frontier science. They are high-quality research data producers and curators addressing global challenges and enabling deep-tech innovation.
Technology infrastructures are facilities, equipment, capabilities and resources to develop, test, upscale and validate new technologies. They can be, amongst others, test beds, pilot lines, cleanrooms and demonstration facilities, and they act as catalysts for Europe's startup ecosystems and industry.

You can read more about the topic in
European Union's website

2. Principles of RDI infra-industry collaboration



2. Principles of RDI infra-industry collaboration

Different collaboration models

There are different ways of organizing the collaboration between companies and RDI infras in practice. The most common ones are listed and shortly described in the following.

Co-Innovation project

A Co-Innovation project is a collaborative initiative funded by Business Finland, where companies and research organizations work together to develop new knowledge and innovations that can lead to significant new business activities of the companies involved. The project consortium consists of at least two cooperating companies, or if one or more research organizations are involved, at least three companies with their own R&D projects. Hence, in practice, if a company wants to utilize research infra in this kind of collaboration, it typically needs to execute its own R&D project. The projects typically have ambitious, high-impact goals and the solutions produced are aimed at having novelty value, market potential and social impact. Thus, the projects are usually longer, typically lasting 2-3 years.

Conrtact research

Contract research refers to research or testing performed at an RDI infrastructure on behalf of a company under a contractual agreement. The client defines the objectives, scope and expected outcomes together with the infrastructure, and the infra provides expertise and resources to deliver the agreed results. Contract research can focus on, for example, solving specific research needs or business challenges, testing the solutions of companies, or supporting product and service development. The size and duration of contract research can vary from a smaller task of a few days to a larger project.

Rental of facilities and equipment

Rental of facilities and equipment refers to RDI infrastructures renting their facilities or separate equipment on their own as a service. The client can use the facilities or equipment to perform, for example, testing or other development activities themselves without utilizing the expertise and personnel of the infra.

Theses: bachelor's, master's, doctoral

Universities and universities of applied sciences can provide an opportunity for companies to provide their students with topics for their thesis of different levels. In a thesis, students conduct research or development as part of their academic degree requirements.

The level of the thesis defines the scope of the project. A bachelor's thesis is the narrowest in scope with a relatively small-scale, typically practical project covering a well-defined problem. A master's thesis usually addresses a more advanced topic involving typically a literature review and an empirical study and takes from half a year to a year to complete. Doctoral dissertation has the broadest scope and aims for academic advancement and original research generating new knowledge. Completing doctoral research typically takes around 4 years.

Some special cases

Shared use of infrastructures

Shared use of infrastructures refers to the practice where multiple organizations, such as companies, research institutions and public entities, access and utilize the same research facilities, equipment, data resources and services. Shared infrastructures can either have open access, partly restricted access or entirely restricted access, for designated partners.

This practice promotes efficient resource utilization, reduces duplication of investments and advances collaboration, knowledge exchange and innovation across sectors. An important factor is also to bridge disciplines and connect academia with industry. They can also become hubs for international researchers.

There are several types of shared research infrastructure. One operational concept is that an organization is the host or owner of the infrastructure and others can bring their equipment and personnel to carry out the task. The collaboration can be applied as campaign / project type of activities but can also be agreed on a more general level.

A more advanced concept is that several parties own and maintain the facility together, which requires institutional level commitment in terms of finances, agreements and governance. Sharing infrastructure can also include a distributed concept where, for example a hardware-in-the-loop system is built utilizing virtual models and physical infrastructures at several locations.

Utilizing the infrastructures of companies

Some companies have their own infrastructures, which they utilize for research, development and testing activities. These infrastructures typically provide a more authentic environment and applications for research and development. Even though the companies possess their own infrastructure, they can still need additional research capabilities that can be acquired through collaboration with external infras.

Infra-industry collaboration in real-world environment

Companies and infrastructures can also collaborate in real-world environment settings. In these cases, the research infrastructure is built on top of an existing production system, and the research object is integrated into an authentic environment and system.

Conducting research in a real-world setting leads to more applicable insights and innovation, as the application is studied in the environment where it is ultimately intended to operate. Typical cases are trialing and validating the functioning of new technologies which are integrated into existing products and systems.

Key items to agree before collaboration

To make the collaboration process smoother, there are several items that should be agreed upon between the parties. Aspects that should at least be discussed, some before making the order agreement, and some in the agreement are listed below. The factors listed here were identified as the most important ones by the companies and infrastructures participating in making the playbook. It is not an exhaustive list of all the matters that could be discussed when beginning the collaboration.

The suitable level on which the aspects should be discussed or agreed on varies case by case. For example, some smaller tasks do not need as extensive project planning and management as more extensive projects.

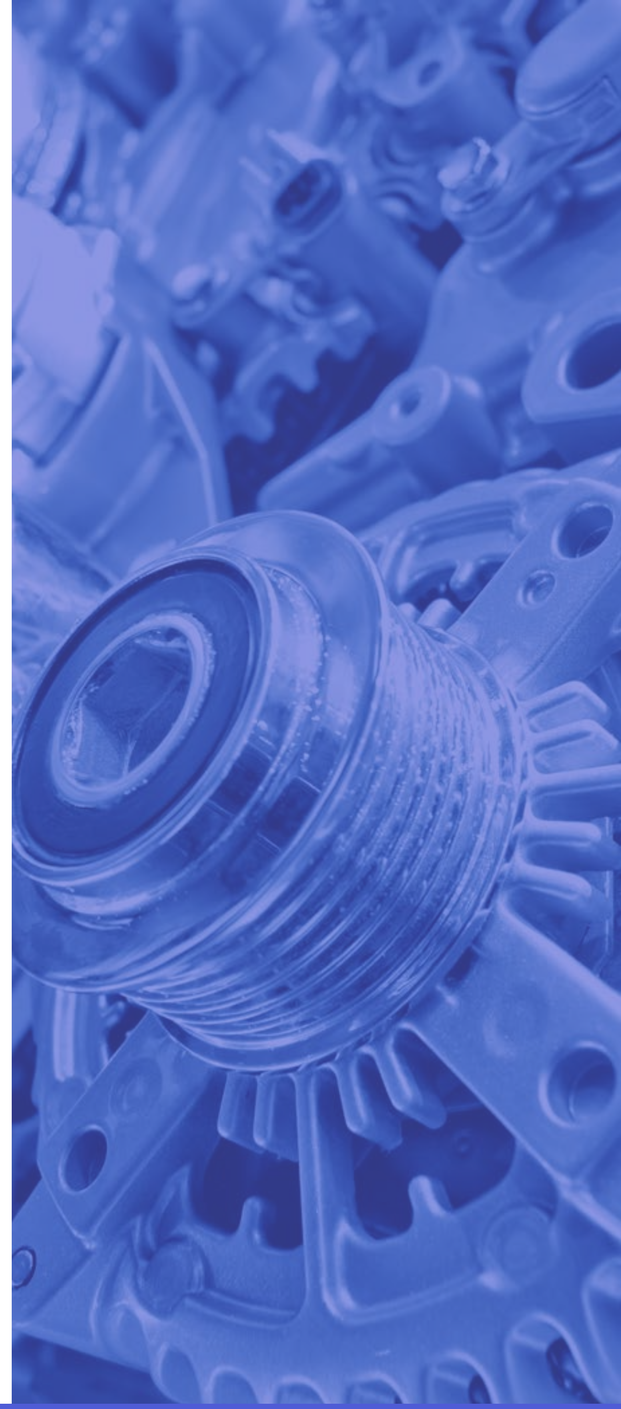
Before making the order agreement

- [ ] Defining customer needs/requirements and infra capabilities:
    - At the very beginning, customer needs or requirements should be defined, to gain understanding of what the customer actually wants to achieve from the collaboration. After that, the parties should ensure that the infrastructure can meet the needs or requirements with their available capabilities.

- [ ] Other ‘deal-breakers’:
    - It needs to be considered case-by-case which aspects are ‘deal-breakers’ for the parties involved. The parties need to define which matters, for example from the list on the next page, should be discussed and agreed on before making the agreement.

In the agreement

- [ ] Confidentiality, security, ownership of the results:
  - NDA, i.e. non-disclosure agreements
  - IPR, i.e. intellectual property rights, including who owns the results, and other legal and commercial terms
- [ ] Sharing the data: who owns the data and on what terms it is shared with other parties
- [ ] Security: different kinds of security issues that need to be discussed related to the process in question, for example, how the company's data and machinery is stored and protected
- [ ] Access permits: who has permission to access the infra's facilities and on what terms
- [ ] Safety related aspects:
  - Responsibilities related to
    - Facility and equipment safety
    - Human safety
  - Procedures related to working alone/in collaboration: for example, can the customer operate in the facilities without infra personnel or can the customer even participate in the activities
- [ ] Project / Task management related aspects:
  - Roles and responsibilities: clearly defining roles and responsibilities of different parties, including project manager and contact persons
  - Project/task planning and schedule: defining project objectives, scope, tasks, resources and timeline
  - Pricing, invoicing posts: defining the pricing, and when and on what terms the work will be invoiced
  - Acceptance criteria for results: defining which aspects need to be completed for the project/task to be finished



Best practices for collaboration

In this section, best practices to support smooth collaboration and successful outcomes are compiled. The practices have been learned through experience by the organizations that were involved in the playbook work and they help to ensure that collaboration flows effortlessly, planning and execution proceed as agreed, and all participants can trust in the shared process.

Project / task management

To ensure the collaboration is as smooth as possible, project and task management skills are needed from both parties involved in the process. Especially, **planning in advance and preparing well** for the project or task are essential. It needs to be carefully considered how the RDI infrastructure will be used and which equipment or materials are needed to execute the planned activities.

That way, for example, the materials needed can be acquired in advance and redundant waiting during the project or task can be minimized. **Infra should be involved in the planning already early on** as they have better knowledge of the infra and capabilities to help with planning the tasks, materials and equipment to use. Systematic planning is also linked to safety as preparing for the process and different tasks in it can decrease the safety risks.

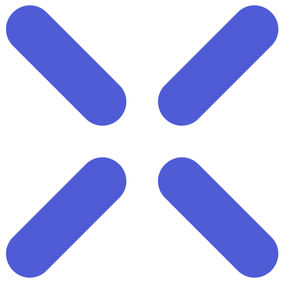
Best practices for project/ task management

- Plan in advance and prepare well for the project/task
- Include the infrastructure personnel already early on in planning
- Reserve enough time, money and other resources for the project/task
- Acquire the ability to prepare for and respond to unexpected situations
- Define clearly the company's requirements for the project/task and make sure they align with infra's capabilities

To make the project or task more successful, **enough time, money and other resources need to be reserved** for it. For example, the above-mentioned planning, preparations and modifying infrastructure require time. Additionally, the ability to prepare for and respond to unexpected situations is essential. In research and development of novel solutions and technologies unexpected events are likely to occur, and plans need often to be modified along the way. Plenty of resources and skills are required on how to react to surprises.

For a successful outcome, an additional requirement from the company is a **clearly defined specification of requirements** and **thorough understanding of RDI infra's capabilities.** The customer has to define what their needs and objectives are for the collaboration. Then, it needs to be ensured that they align with the capabilities of the infra and confirmed that the infra can adequately fulfil the requirements.

To ensure a smooth start to the collaboration, the infra has to actively communicate their capabilities. The communication can be through the service description, for example, on their own website or describing the capabilities proactively when the company makes the first contact to inquire about possible collaboration.



Collaboration

It should be remembered that collaboration happens between people – not organizations. The **roles and responsibilities of all parties involved should be defined** at the beginning of the process. Additionally, to make the collaboration more successful, people appointed should be willing and able to commit their time to the project or task. That way **owners of the activity from both parties would be identified.** Additionally, **the operational people or teams from both parties should communicate directly and have mandate to handle tasks.** That would, for example, make responding to surprises and changes easier and quicker.

Active collaboration between parties is essential to successful outcomes. **Ongoing dialogue** between parties is recommended. One way to do that is through industrial advisory boards of RDI infras where a group of company representatives discuss regularly with infra representatives.

Knowing each other and understanding the needs and capabilities of the other party are essential for successful collaboration. That can be achieved, for example, through active dialogue. Communication between parties helps to build trust that is key to fruitful collaboration.

Additionally, **sharing data with others whenever it is possible** is recommended. Sharing high-quality data based on real-life measurements accelerates scientific progress and innovation, when both parties have more data to work on. In addition, sharing data saves resources by reducing duplication as there is no need to collect data separately, but different parties can use the same already existing data sets.

Best practices for collaboration

- Define roles and responsibilities of all parties involved
- Identify owners of the activity from both parties
- Ensure direct communication between the operational teams from both parties
- Grant the operational teams mandate to handle tasks independently
- Be active in the collaboration and facilitate ongoing dialogue
- Make the effort to get to know and understand the other party's needs and capabilities
- Share data with others whenever it is possible

RDI infra competencies and management

Available RDI infra competencies affect the success of the project or task at hand. Thus, infrastructure should **ensure that necessary supportive functions**, such as high voltage installations, are available either from the own resources of the infra organization or through known and available partners. Additionally, the **accumulation of expertise** and **continuity** in the infra should be assured.

As frequent changes in personnel can create challenges, the organization should make sure that if experts leave, both explicit and tacit knowledge will still stay in the organization. Continuity can be ensured by, for example, making sure that multiple people within the organization are capable of operating each piece of equipment in the infra.

The ability of infras to proactively suggest additional research opportunities is seen as an asset by the companies, and that can become possible only if the knowledge is accumulated in the organization.

For managing the RDI infra as a whole, **a person responsible for the infra** should be assigned. The person should have a more permanent position and visibility over the whole infra. Expertise could then be gained during the different opportunities the infra provides. Thus stronger understanding of the long-term customers obtained, as well. A development plan of the infra would be beneficial for the continuity of the infra in the long run.

Best practices for RDI infra competencies and management

- Ensure that necessary supportive functions are available in the infra
- Assure accumulation of expertise and continuity in the infra
- Assign a responsible person for the infra with a visibility over the whole infra

Collaboration possibilities to be considered

Intention for collaboration and sharing future visions

Aiming to collaborate with different parties and sharing future visions frequently would be beneficial for all parties. RDI infra operators wish to have longer-term visibility of company needs and what type of services companies would be interested in acquiring externally. That would support infras in making investment decisions and planning their future operations. In return, it would lead to more relevant infras for companies to utilize. Sharing future visions can also enable more coordinated development and investments into the infrastructures nationally. That would decrease the amount of underused infras and unhealthy competition as each infra could focus on their core capabilities.

One example is the collaboration between selected universities and SIX Mobile Work Machines cluster through the cluster's roadmap. The cluster has a shared roadmap created and maintained by companies describing the joint future visions of mobile machinery in 10 years. The universities have used this industry roadmap to create their corresponding version of the research topics and infra development needed to reach the industry's future vision.

Seeking for synergy benefits beyond industry borders

Even though an RDI infra may focus mainly on one single industrial sector, its capabilities can also provide value to companies within other industries utilizing same technologies or facing same kind of challenges. For example, there are plenty of infras that are not explicitly focused on mobile work machines, but which could support also companies from the field.

RDI infras and companies are encouraged to broaden their approaches and seek collaboration beyond their own field: infras should improve their visibility regarding their suitability for the use across different industries, and companies should open-mindedly explore solutions and services beyond their own industry.

Active collaboration between RDI infras

Collaboration between RDI infras can be beneficial in multiple ways. For instance, joint development can have economic advantages as joint investments can lead to stronger outcomes. Combining fundings enables building a better infra with stronger capabilities than if the infras use the fundings individually to build similar facilities or equipment. Collaboration between RDI infras in projects or other activities can also lead to more diverse utilization of infras when strengths of different infras are leveraged. Facilities and capabilities of different organizations can be combined within one project: one organization may have suitable facilities, but not needed knowledge, so another infra could provide their capabilities to solve the customer's problem in collaboration. Sometimes the amount of instrumentation and equipment required can be so large that it is beneficial to combine efforts from various parties.

Active collaboration between companies

Active collaboration related to RDI infra utilization can be also economically beneficial for companies. Combining the research needs of multiple companies creates larger, more impactful projects that are more suitable as research projects for universities and research institutes. Additionally, coordinating similar types of testing that require the same test setup will reduce costs, as the same facilities could be used for the different tests in question. In some cases, it can be beneficial to combine the components and products of various companies as subsystems to a larger system. The different subsystems can give their contribution to the system and bring new information on, for example, how the products should be further developed to make the whole system more efficient.

3. Accessibility of RDI infrastructures and their services

3. Accessibility of RDI infrastructures and their services

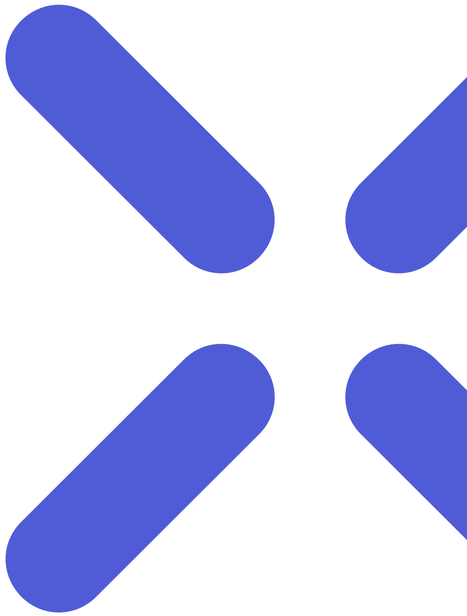
Definitions

Service

A service is an organized activity or solution provided by an RDI infrastructure to support the needs of research, development, or innovation of a customer. Services can include access to facilities, equipment, expertise, testing, training, or other capabilities of the infra. An RDI infrastructure or its equipment alone does not constitute a service: rather, the capabilities of the infrastructure and the outcomes it enables form the service offerings. Services provide an interface through which it is easier for customers to engage themselves with the infra as it is clearer to see the value the infra can provide for the customers.

Customer orientation

Customer orientation means designing and delivering RDI infrastructure services with the customer's needs, goals and experience in mind. It requires understanding the business challenges companies face and presenting the infra's capabilities as clear, value-driven solutions. The infra should consider who its potential customers are and what their special features are. When services are designed and described in a way that resonates with potential customers, the right stakeholders become interested in the offerings of the infrastructure. It is essential to consciously select the language and terminology used in the service descriptions so that the target audience recognizes the RDI infrastructure as highly relevant and suitable for their needs.



Service description elements

Each RDI infrastructure should have a clear service description so that its services are easy to find and use. The service description should include certain key elements which are listed on the next page. These elements are grouped into two categories: essential elements (which must be included) and recommended elements (which are optional extras). The level of detail for each element can vary depending on the specific RDI infrastructure.

Essential elements

- The name, home organization and location of the infra
- Up-to-date contact person
- Operational overview of the infra
  - Service description should have a short high-level description of the operations and possibilities of the infra. The reader should be able to recognize whether the infra is relevant for them already from the description.
- Capabilities of the infra
  - An overview of the capabilities
  - Accurate main specifications of the infra described with a level of detail appropriate for the customer group. The description should include performance criteria and, for example, system interfaces and standards.
  - Certificates and accreditation, if available
- Service models and collaboration models available in the infrastructure
- Basic pricing when applicable
  - If explicit pricing cannot be presented the service description could include price range or example cases with their pricing
- Short description of practices related to
  - safety
  - security, level of confidentiality
  - legal and commercial terms

Information presented in the service description should always be kept up to date

Recommended elements

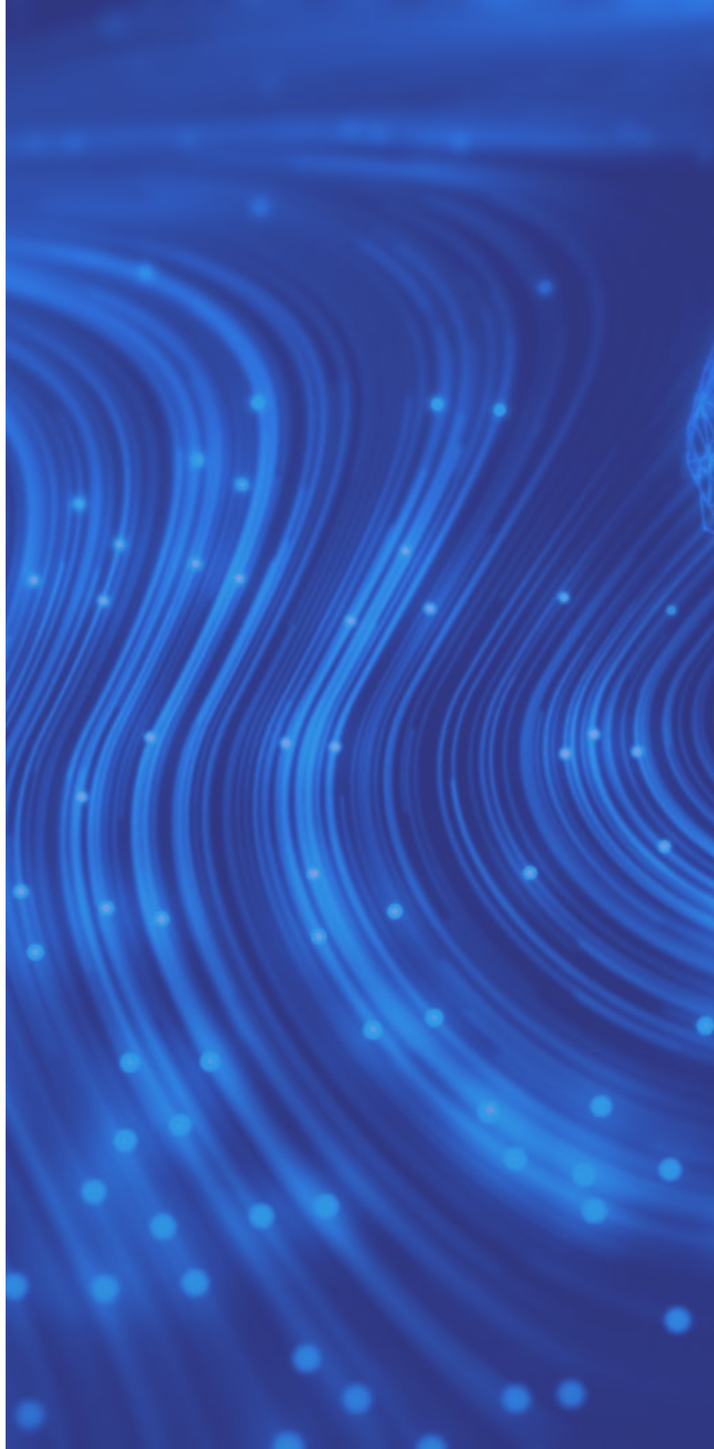
- Case examples of previous infra utilization and references
- Links to public results related to previous cases utilizing the infra
- Presenting the personnel and expertise
- Pictures and videos of the infra and its usage
- Preparation time required
  - Describing a typical preparation time for e.g. a testing period, to indicate how much in advance the customer should contact the infra

Visibility of RDI infrastructures

Maintaining good visibility is essential for attracting collaboration and ensuring companies discover easily the RDI infrastructure and its services. Infras should ensure their information is accessible and up to date on their or their organization's website, with intuitive navigation. Finding the website should be made as easy as possible for potential customers, so search engine optimization should be considered. Additionally, infras should actively keep themselves listed in relevant databases, such as tiedejatutkimus.fi website in Finland.

It is essential to realize that **visibility requires continuous effort**. Service descriptions, contact details, information about the capabilities of the RDI infra and information added to external databases should always be kept up to date. Additionally, professional networks, social media and industry events can be used to increase visibility and highlight the value infra can bring to its customers. Infra should identify the key channels they should be visible in to reach their potential customers. Active participation and communication help to build trust and promote opportunities for collaboration.

4. Building mutual understanding: Key aspects of RDI infras and companies



4. Building mutual understanding: Key aspects of RDI infras and companies

RDI infrastructures and companies view the same world from different angles, each with their own starting points and priorities. Understanding the other party and its underlying context make collaboration smoother and more effective. This section brings together key insights about RDI infrastructures and companies that each side should know to facilitate successful cooperation.

Key aspects companies should understand about RDI infras

It is essential to acknowledge that there are many kinds of RDI infras and they can have different goals, operating models and capabilities: the context and operating models of a testing infrastructure of a commercial operator are totally different from those of a research infrastructure of a university. **All RDI infras have their specific strengths and they can provide solutions to different kinds of needs and requirements.**

A company that wants to utilize the services of infras should firstly clearly identify its own needs so that it can find the right partner to collaborate with. For example, commercial operators can often handle smaller assignments with faster schedules than universities. Universities typically require larger, long-term projects for it to match the needs of the infra, but they usually have better capabilities to research, for example, totally new ideas and concepts.

As RDI infrastructures can vary significantly, they also have different objectives and means how their performance is evaluated. **Key performance indicators (KPIs) can differ between infras.** For universities, collaboration with companies or infra usage is not, as such, a KPI, but infra is needed to produce research output which is a KPI. For commercial operators providing infra services as their business, the case is different. It is beneficial for the collaboration that companies acknowledge the differences between different RDI infras and their objectives.

Key aspects to understand about RDI infras

- All RDI infras have their specific strengths and they can provide solutions to different kinds of needs and requirements
- KPI's differ between infras

One critical aspect companies should understand about **universities** is that they **always have a research dimension** in their activities. As stated above related to the KPIs the objectives of universities focus heavily on generating scientific research output. That has a strong effect on which kind of collaboration and projects they prefer to participate in. Additionally, **universities often have limited permanent staff.** That leads to some challenges in engaging with short-term projects at short notice as typically all the researchers have their research projects ongoing. This also means that resource allocation needs to be agreed case by case as it depends heavily on the current situation.

Universities of applied sciences share many similarities with universities. As educational institutions, their primary focus is also on teaching and generating research output. However, **they typically have a larger share of permanent staff**, which enables potentially shorter response times and more agile collaboration also in smaller projects.

A typical feature of **RDI infrastructures of universities and universities of applied sciences** is that they **are often continuously evolving and require ongoing development.** They are not finalized and static, but can, and often need to, be modified to match the requirements of the project in question. That provides an opportunity for a most suitable setting for the project, but it also means that it needs to be taken into account when considering the project schedule as the development and modifications to the infra take time.

As noted above, **for commercial RDI infrastructure operators, offering infrastructure services and serving companies are their core business.** This often means that they can deliver services on shorter timelines. Their objective is to run a profitable business which then guides their operations. Companies should note that **commercial operators handle customer requests with full confidentiality** to ensure trust and service quality.

While this is a valuable feature, it also means that if a customer wishes to seek synergies, such as reducing costs by combining their tests with other companies' tests that use similar setups, the responsibility for arranging such collaboration lies with the companies themselves.

Key aspects RDI infras should understand about companies

Companies are result-oriented and it usually steers their decision-making. They often have limited time available to projects or tasks and obtaining the results from them. That also leads to **the need for efficient and precise management of the project or task** in the research or development activities they do with RDI infras. Companies might face more often time pressure during a project than the infra involved as delays can lead to significant costs for the company.

RDI infras should also acknowledge that **the way and the time frame in which the findings of public projects are disseminated make a difference for the company.** Publishing findings may threaten the future competitive position of the company if the competitors learn about the company's future visions. The publishing itself may not be an issue, but the content and the timing of publications matter. **Publishing the results should always be agreed upon with the companies involved in advance.** For example, in Co-Innovation projects these are agreed already in the consortium agreement.

The spectrum of companies' infra needs is broad. Companies require different types of RDI infrastructure services at different stages of the research-to-product pipeline. At the early stages, new technologies need to be explored, even at the level of basic research. Agile contract research is also valuable at this point to quickly test new ideas and prototype concepts.

In later stages, the focus shifts to testing nearly finished products, validating their performance, or conducting deployment tests before large-scale implementation or investment. Companies may also need RDI infrastructure services for certification, testing compliance with industry standards, or increasing skills and knowledge of their own employees.

Key aspects to understand about companies

- Companies are result-oriented which creates a need for efficient and precise project/task management
- How and when the findings of public projects are disseminated make a difference for the company
- The spectrum of companies' infra needs is broad
- The size and the maturity of the company influence its operating practices, needs and available resources

RDI infrastructure needs vary in scope as well. A company may require research or testing at the level of individual components, modules, or complete products and systems. The scope sets requirements for RDI infrastructure capabilities. In the field of mobile work machines, full-product testing demands large facilities and powerful equipment.

Large machines also introduce safety challenges: infrastructures must ensure compliance with safety requirements and provide secure storage for machines throughout the testing period. In addition, testing heavy machinery creates companies need to collaborate with RDI infras as it can require the possibility to test in extreme conditions and spacious environments that companies cannot create in their own facilities.

As the spectrum of companies' RDI infra needs is vast, the companies might benefit from guidance provided by the infrastructures on finding the services most suitable for their situation. RDI infras have deeper insight into the infras' capabilities and research and testing opportunities, and this expertise enables them to recommend the appropriate activities.

The size and the maturity of the company influence its operating practices, needs and available resources. Large companies usually have more resources at their disposal in research and development activities than small and medium-sized enterprises, but startups might need more support from the infras as they are still at the beginning of their journey.

5. Typical process in collaboration: Selecting an RDI infra partner and infra utilization

5. Typical process in collaboration: Selecting an RDI infra partner and infra utilization

RDI infra-industry collaboration starts typically with selecting a suitable infra partner based on the needs of the company and the project/task at hand. In this section key aspects to be considered when selecting an RDI infra partner to collaborate with are discussed and a typical RDI infra utilization process is described at a high-level.

Key aspects to consider when selecting an RDI infra partner

There are multiple aspects that affect selecting a suitable infra partner for the RDI infra-company collaboration. The key aspects to consider are presented in the figure on the next pages.

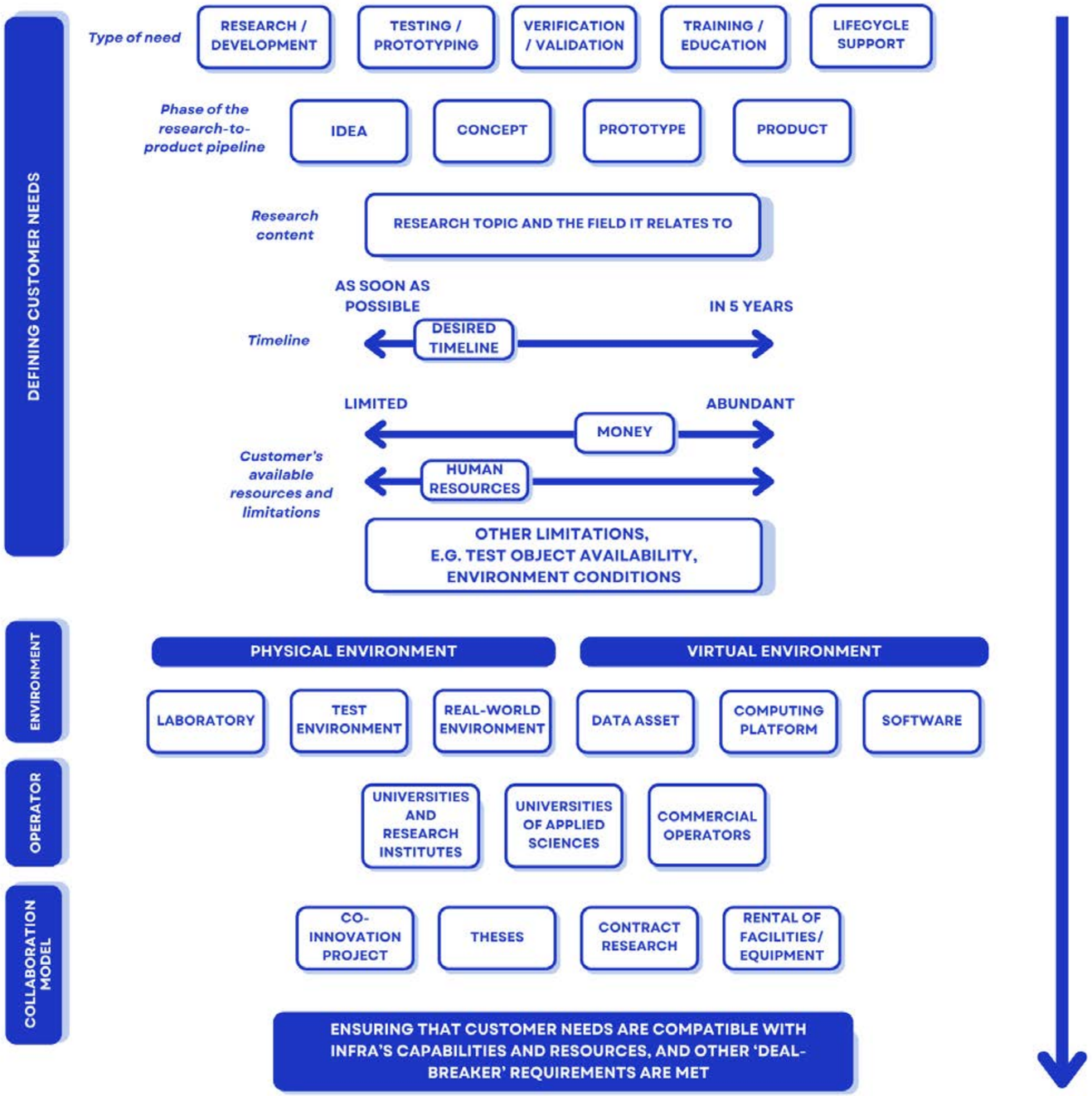
To be able to identify a suitable infra partner the customer has to define its requirements for the collaboration. In the upper part of the figure, key considerations related to the customer's needs are presented.

The customer should consider the primary objectives of the project/task – whether it addresses, for example, research and development or training and education related activities. Additionally, the customer should identify which phase of the research-to-product pipeline the project/task relates to. The research content naturally influences which RDI infra is suitable for the project/task as infras have different capabilities.

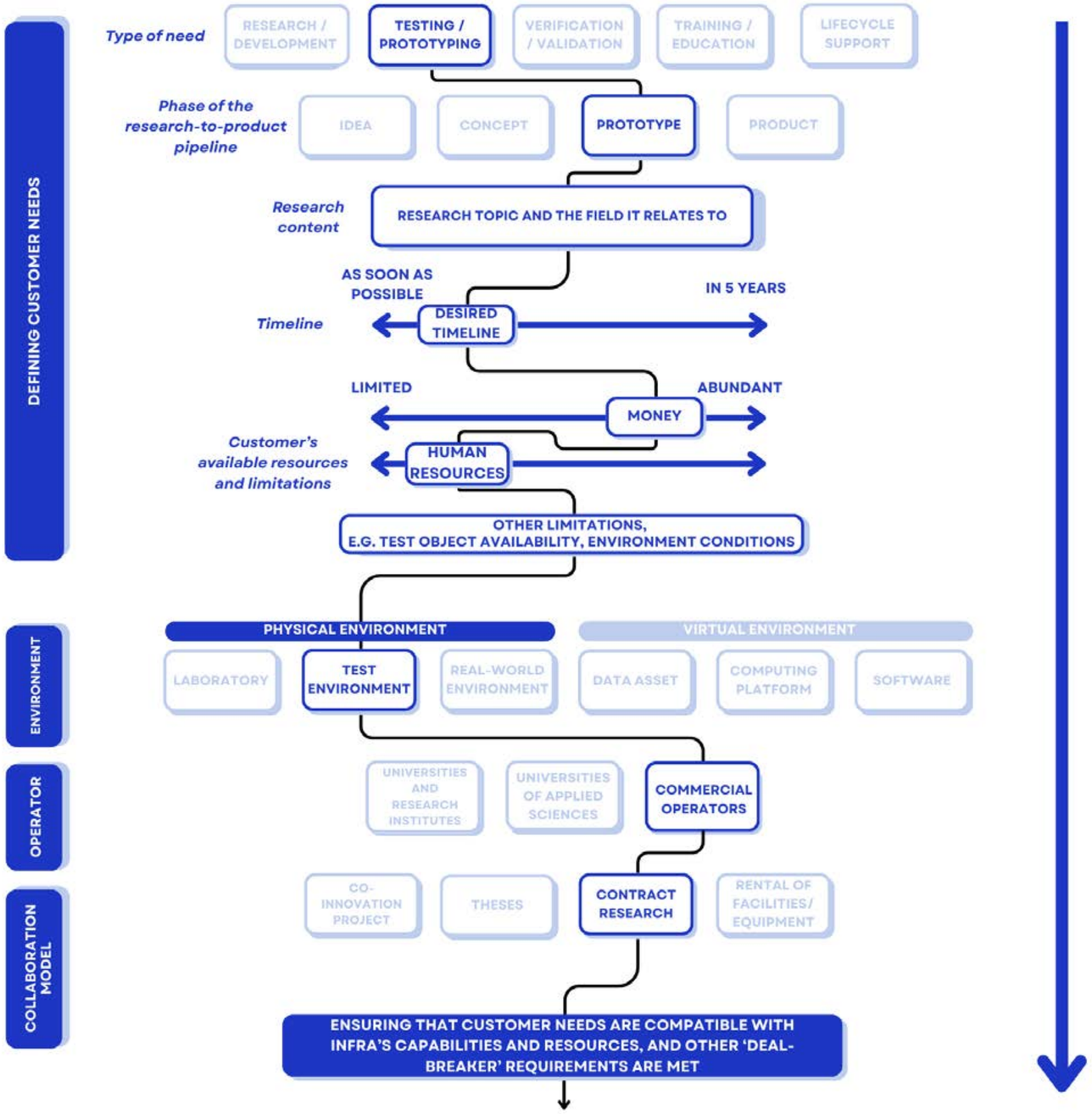
The desired timeline, customer's available resources and limitations also affect the decision: different infras are more suitable for the project/task depending on how fast the project/task would ideally be completed and how much money and human resources the customer is able to allocate to the activity. Additionally, there might be some limitations affecting the decision. For example, the availability of the test object or system, and even environment conditions, such as restrictive weather conditions, can affect the possible timeline.

The defined needs of the customer guide the decisions related to the aspects presented in the lower part of the figure. **It should be considered which type of environment, RDI infra operator and collaboration model can provide an appropriate solution for the customer's requirements.** After identifying a potentially suitable infra partner, it is essential to ensure that the needs of the customer are compatible with the capabilities and resources of the infra, and that other essential requirements, or 'deal-breakers', are met. That will ensure both parties are well-matched for a successful collaboration.

The considerations do not need to follow the specific order presented in the figure. Also, other factors may be relevant to be considered depending on the case in question. The selection process might start from a certain perspective, or the customer may need to adjust the requirements after obtaining additional information about, for instance, resource scarcity of the infra otherwise suitable for the collaboration. Additionally, same needs of the customer can lead to several different suitable infra partners as the path is not definitive.



Key aspects to consider when selecting an RDI infra partner



Example case of selecting an RDI infra partner

In this figure, an imaginary example of selecting a suitable infra partner is presented to illustrate the selecting process. In the example, the customer has a need for collaboration with an RDI infra related to testing its new prototype. They would like to have the test done quite soon to be able to continue the development process. Testing the prototype is seen as essential in the customer organization so they are willing to allocate money to the activity, but currently they have human resources scarcely available for this additional task.

Based on these requirements, the customer needs an RDI infra partner with physical test environment. As they would like the timeline to be short and they have budget available, collaborating with a commercial infra operator seems suitable. With that kind of operator and task at hand, contract research is decided to be the most suitable collaboration model.

Then the customer has to find a suitable commercial operator that operates in the desired field and ensure that company's needs are compatible with that infra's capabilities and resources.

Typical RDI infra utilization process

Details of RDI infra utilization process vary case-by-case depending on the parties involved. A typical RDI infra utilization process is described below at a high-level to display the different phases usually present in the process.

1) Customer defines its objectives and requirements for the infra utilization

2) Customer selects a suitable infra partner and contacts it

3) Discussing objectives and needs between the parties
    - Company's needs are compared to the infra's capabilities to check whether they align with each other

4) Infra operator formulates a proposed solution, taking into account the infra's available resources

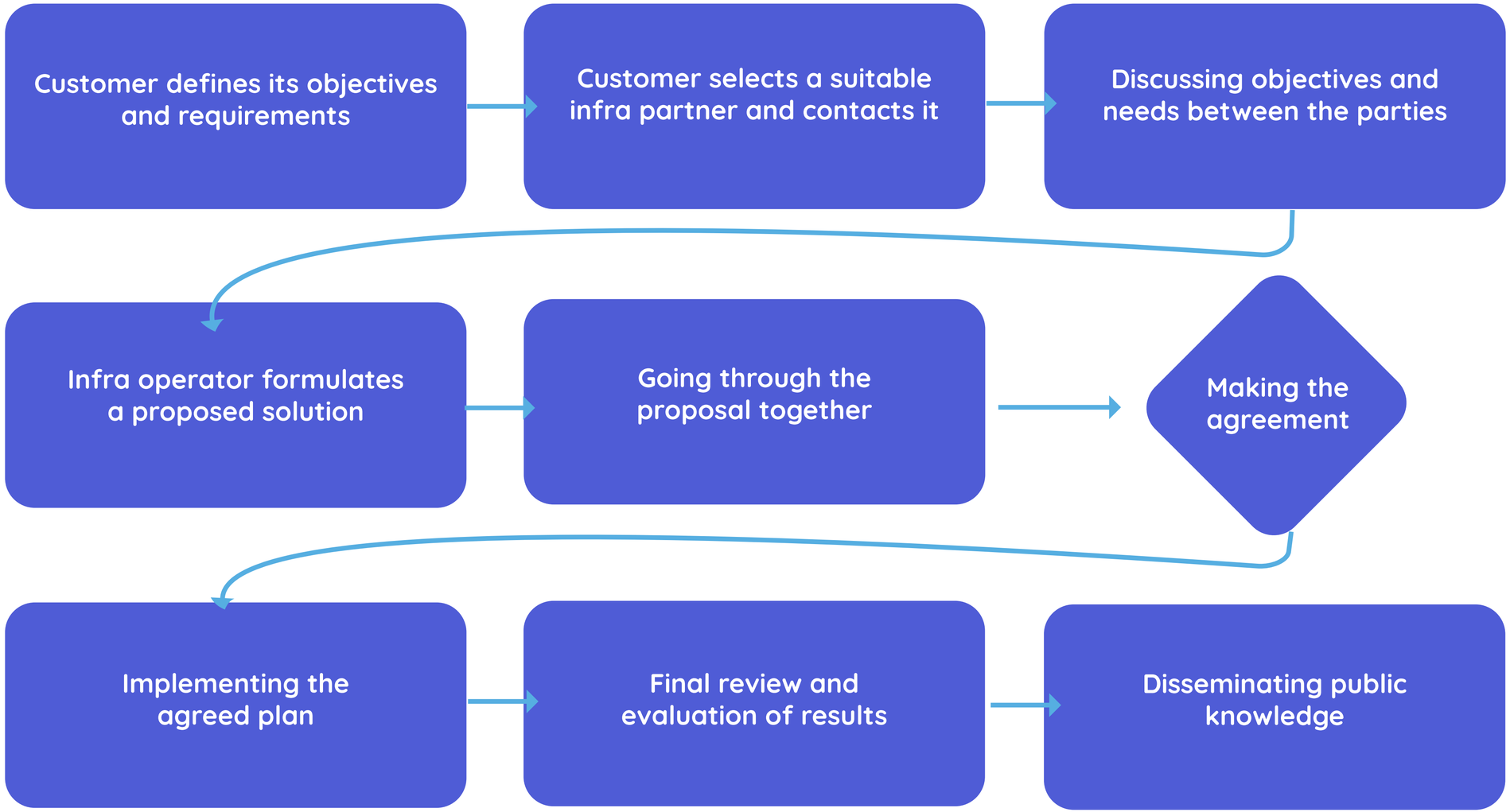
5) Going through the proposal together with both parties and modifying it if necessary

6) Making the agreement

7) Implementing the research or testing according to the agreed plan

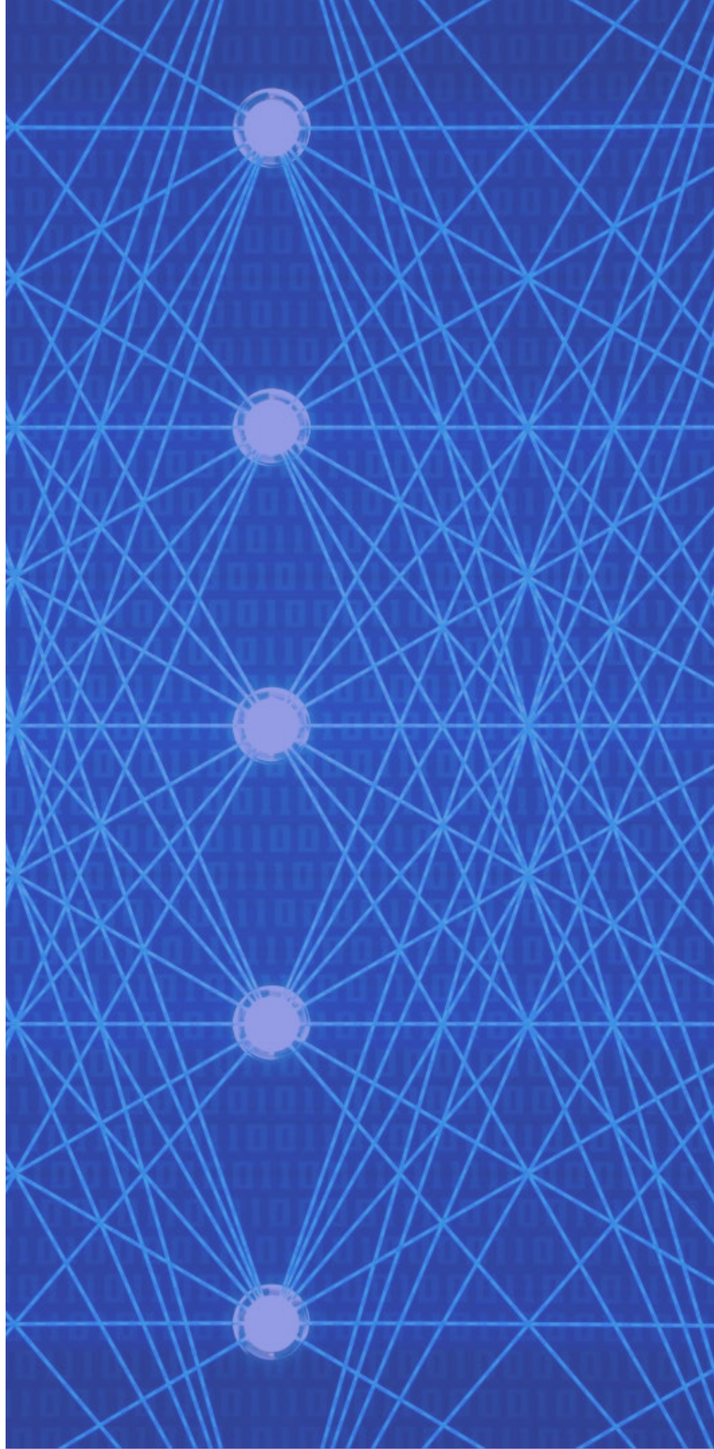
8) Final review and evaluation of results

9) Disseminating public knowledge to increase awareness and deliver value to both infras and industry
    - For example, publishing public results, writing a case story to the infra's website and sharing the data sets in ways that is possible and agreed



Typical RDI infra utilization process

6. Case examples: Best practices in RDI infra-industry collaboration



6. Case examples: Best practices in RDI infra-industry collaboration

Case example: Collaboration with a university of applied sciences infra

When we set out to conduct a testing project with a research infra at a university of applied sciences, we knew from the start that success would depend on close cooperation and thorough preparation. Before the actual testing, we held a series of meetings involving both the lab team from the infra and our own test engineers.

These discussions were essential for understanding the infra's capabilities and for clarifying, for example, in what format the work cycle data should be delivered for it to be suitable for the testing system, and to ensure all interfaces were compatible.

A key factor for success was realistically estimating the time needed for installation, commissioning of the test arrangement and actual testing.

The process included not only the testing itself, but also data collection and reporting. We analyzed the results together and assessed whether there is a need for further testing. At the end of the project, we held a joint 'lessons learned' session to discuss what went well and what could be improved - this reflection was valuable for both us and the infra team.

These kinds of more complex testing projects are not always entirely straightforward. Even though we carefully reviewed the details and prepared in advance, surprises still occurred, as a missing component delayed the start of testing. With several people committed to the project, waiting around is not really an option, so in the future, we will pay even more attention to project risk assessment and make sure all necessary parts and systems are available before testing begins.

- **Kalle Einola**
  Director, Research & Programs
  Ponsse

Best practices in infra-industry collaboration at IHA, Tampere University

At Innovative Hydraulics and Automation (IHA) laboratory at Tampere University, we believe that successful innovation in the field of off-road mobile machinery and its advanced control systems starts with clear communication, defined roles and infrastructure planning.

In 2023 we formed industrial advisory board of IHA and conducted requirement analysis for future needs. Advisory board consists of established industrial partners (OEMs) and board meetings are organized in person quarterly to review our progress. Under guidance of the advisory board, a development road map and IHA's vision strategy were developed for next 5 and 10 years.

In recent years, our laboratory has undergone significant modernization of its infrastructure, with a strong focus on safety and the flexibility of our test rigs. We prioritize adaptable designs so that our test rigs can easily adapt to the latest technologies and respond to companies' needs and planned research topics. Safety is a key priority, and it is supported by regular safety committee meetings and ongoing supervision.

Each test rig has a responsible supervisor and dedicated 2-3 researchers to maintain accumulation of knowledge and skills in the group. More experienced researchers introduce test rig operations and safety instructions to new researchers. As researchers progress through their careers in the lab, they transition from operating simpler test rigs to more advanced ones. This approach supports continuous skills development and ensures that multiple researchers are qualified to operate each test rig.

We share regular updates via LinkedIn, X and email on our research progress, milestones and collaborations to keep our community engaged and informed. We noticed that this transparency builds trust and attracts new industrial partners.

Continuous improvement is key. Clear communication and structured planning ensure that IHA research translates into real-world impact faster and more efficiently.

- **Prof. Dr. Tatiana Minav**
  Innovative Hydraulics and Automation
  (IHA) laboratory
  Tampere University

Best practices in protoshop-research collaboration at Kalmar, Tampere test yard

Successful and effective collaboration between Kalmar and research at Kalmar Test Yard in Tampere requires clear communication, shared goals, and defined processes. Here is the list of practices we have followed in such cases:

1. Clearly define the research goals, test yard requirements, and expected outcomes of the collaboration.

2. Assign a dedicated point of contact or project lead from both the protoshop, Kalmar's test team and research team. Define who is responsible for maintenance, testing, data security, and compliance.

3. Create a formal document outlining the scope, deliverables, timeline, and success metrics for the testing project.

4. Schedule frequent, brief meetings (e.g., weekly stand-ups) to discuss progress, address roadblocks, and ensure alignment and document them in Jira.

5. Use a shared platform (Google Docs and/or Confluence) for all project-related documentation, meeting minutes, and change logs.

6. Establish a formal process for researchers to provide feedback on the test yard's performance and for the protoshop and test team to provide updates on system changes or maintenance.

7. Implement clear protocols for access to test yard environments. Ensure all data handling complies with Kalmar's and relevant security and privacy standards.

8. Proactively forecast the computing, storage, and networking resources needed for the research and establish a scalable plan with the test team.

9. Where possible, standardize the tools, environments, and data formats used to reduce complexity and integration issues.

10. Provide thorough training for researchers on how to effectively use the test yard.

11. Ensure that technical test yard documentation is accessible and understandable to researchers.

12. Encourage joint problem-solving between protoshop, test team and research personnel to build mutual understanding of challenges.

13. Conduct a review after major project milestones or upon completion to identify what worked well and what can be improved for future collaborations.

14. Treat collaboration as an iterative process, regularly soliciting input to refine practices and adapt to evolving research needs.

- **Pekka Yli-Paunu**
  Director, Research
  Kalmar

Example on experimental work and data collection at industry facilities and sites – Considerations

Regarding the electrification of non-road mobile machinery (NRMM) it is essential to obtain and analyze data on how the existing systems work and what parameters are affecting the performance of the systems. Investigation of the systems in real environments is essential to support scientific research. The experimental set-ups and collection of data need to be planned well ahead to carry out the work at the site efficiently and safely. There are certain specific aspects that need to be considered in the flow of data acquisition to the analysis and research.

For example, a significant ongoing activity includes the energy infrastructure of a major port in Finland being analyzed to summarize the current situation and provide what-if scenarios for NRMM energy mixes and electrification. The test case offers insights into the complete logistics chain, utilizing all available data sources for both NRMMs and heavy-duty vehicles, which are shared within various data spaces. Models are being set up for scenario evaluation, and the dataspace is simultaneously under development.

An essential area of collaboration between the industry and research partners is on acquisition of data, which includes several key points to be considered:

- **Vendor-specific data:** Available parameters vary widely, from sparse to comprehensive datasets. Data acquisition can be offline or near real-time, and real-time collection remains challenging.
- **Granularity:** Data ranges from time-sampled (minutes, hours, weeks) to event-based, with some vendors providing only limited event data. Downloaded data is often scattered and unsorted, with missing entries.
- **Evaluation examples:** Vehicle and NRMM scenarios can been analyzed using, for example, Matlab live scripts, allowing easy data review and future automation of data collection and analysis.

Specific attention needs to be paid to define the task under investigation from the overall higher-level objective to the concrete planning of the events at the site to the instrumentation and data collection considering the later use of the data. The importance of communication between all the stakeholders cannot be emphasized enough in terms of data collection and utilization.

Defining the test cases and arranging and managing the representative equipment, operating cycles and scenarios on site are of high importance. Mutual understanding needs to be reached on ownership and data sharing procedures between all parties.

Working in operational industrial environments can include factors and situations that are not present in laboratory set-ups. All safety measures are to be carefully considered together with the site and equipment providers and the researchers according to the procedures of the infrastructure providing party.

Field work outside laboratory facilities requires at least the following matters to be considered:

- Experimental work in the field requires the validity of the occupational safety card.
- A risk assessment of different types of field work should be carried out already in the planning phase of the project. In some cases, it is useful to visit the site in the field in order to better assess what is required to do the work and what kind of risk factors and requirements the site has.
- Assess the risks together with all stakeholders on site before starting the work. Also be prepared that the work may not progress as planned.
- Thorough induction is especially important in risky work.
- Protective equipment is required at the destination, for example helmet, hearing protection, harness, life jackets, eye protection, safety shoes, respirators, flashlights.

Additional time spent on planning the experimental set up and the workflow will lead to higher efficiency and safety in the actual work carried out at the site itself, looking for minimal interference and hindrance to the production process of the whole site under investigation.

- **Johannes Hyrynen**
  Research Manager, Transport Technologies
  VTT Technical Research Center of Finland

7. Closing remarks

7. Closing remarks

Collaboration between companies and research, development and innovation infrastructures is not just an opportunity, but a strategic necessity for driving development and competitiveness. By working together, we can accelerate innovation, share knowledge and make the most of existing resources. The playbook was compiled to support streamline RDI infra-industry collaboration and its processes. It brings together lessons learned and best practices based on the experiences of a diverse group of professionals.

However, processes and ways to operate are evolving, and new insights are gained constantly. Thus, the aim is to keep this playbook a dynamic piece that is updated as needed for it to continue supporting RDI infra-industry collaboration also in the future. As highlighted in Finland's National Mobile Machine Growth Strategy 2035, the industry's ambitious goals - tripling revenue, creating tens of thousands of new jobs and positioning Finland as a global leader in R&D - can only be reached through strong partnership. Through collaboration these shared visions can be turned into reality.

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SIX Mobile Work Machines

SIX Mobile Work Machines cluster, established in December 2020, is an industry-driven cluster that gathers mobile machine OEMs, technology solution providers and academia under one roof to jointly innovate and solve the industry's grand challenges, foster competence development and availability, and further develop the competitive operating environment for mobile machine development.

SIX Mobile Work Machines

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