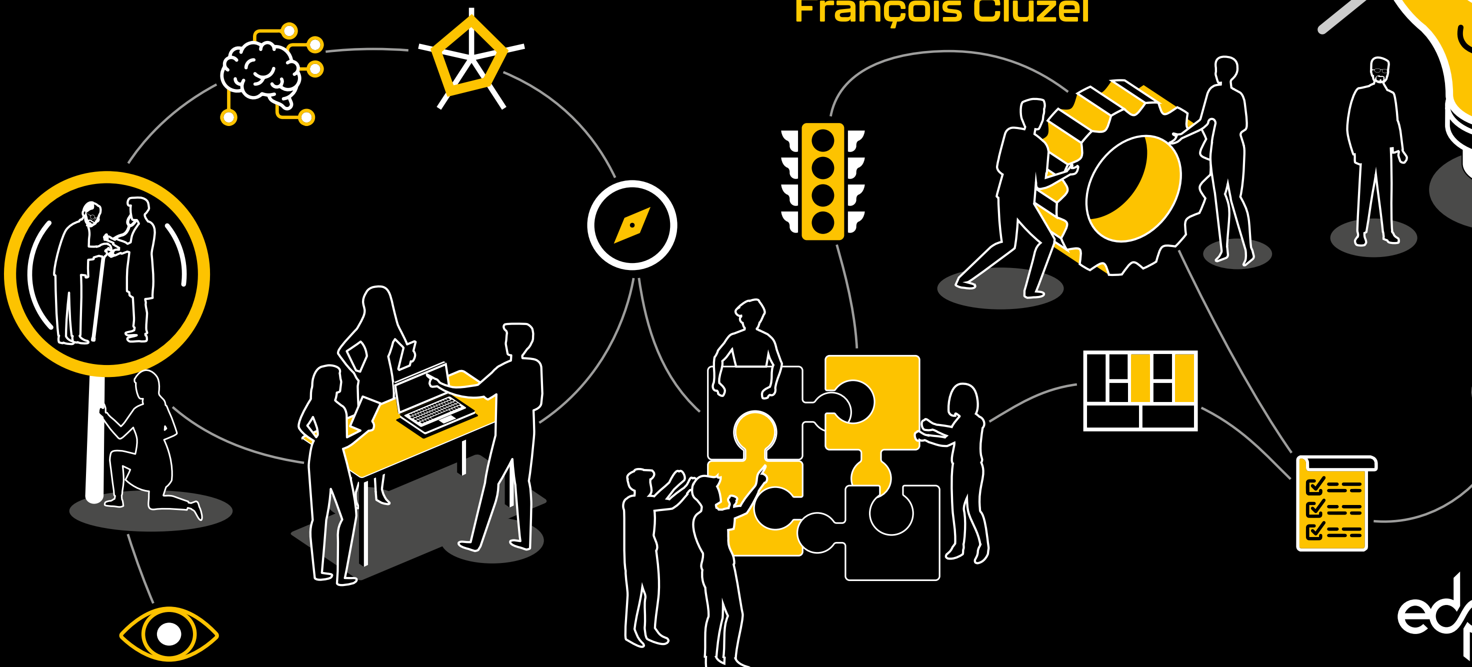
# Radical Innovation Design

A systematic and usage-driven innovation methodology to ensure usefulness for users and profitability for companies

Bernard Yannou
François Cluzel



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CentraleSupélec

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E-BOOK
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# Introduction

# What kind of innovation?

**Why and for what purpose do you want to innovate?**

**What future do you want for yourself, your children and your customers?**

**Is there a best method, organization, process to innovate?**

**Can I claim that my innovations have contributed to the values that are mine or that I wanted to promote?**

***Here are just a few of the many questions you have already asked yourself, or will be asking yourself in an innovative design situation.***

# Preconceived ideas about innovation

## Do you have doubts, or are you tired of certain preconceived ideas about innovation?

### In general

**Innovation is risky** – This belief overlooks the fact that innovation can also be a calculated, systematic process with manageable risks, especially in cases of incremental innovation or when guided by thorough research, careful planning, and systematic user evaluations.

**Innovation is expensive** – There is a belief that innovation requires significant financial investment. While this can be true, many impactful innovations have been developed with minimal resources.

**Big companies can't innovate** – This misconception suggests that large companies are too slow and bureaucratic to innovate effectively. In reality, many large companies have the resources and capabilities to drive significant innovation.

**Innovation happens in isolation** – The stereotype of the lone genius innovating in isolation is prevalent, but most innovation is collaborative, involving teams, partnerships, and knowledge-sharing across different disciplines.

## On nature of innovation

**Innovation equals technology** – People often equate innovation strictly with technological advancements, overlooking non-technological areas such as service, process, organizational, or business model innovations.

**Innovation only happens in high-tech sectors** – There's a common belief that innovation is restricted to high-tech industries like IT or biotechnology. However, significant innovations can and do occur in any sector, including traditional industries like manufacturing, agriculture, and services.

**Innovation is solely product-oriented** – There is a tendency to focus solely on products when thinking about innovation. However, innovation can occur in services, processes, business models, and organizational structures as well.

**Sustainability and innovation are incompatible** – There is a misconception that sustainable practices stifle innovation. In fact, sustainability can actually be a powerful driver for innovation, pushing companies to develop new, more efficient, and environmentally friendly solutions.

**Innovation is always technically complex** – The assumption here is that innovation must involve complex technologies or processes. In fact, some of the most effective innovations are simple and based on clear, straightforward ideas.

*Text in dotted boxes directs you to the corresponding fact sheets in the book. Go back using the keyboard shortcut:*

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# Preconceived ideas about innovation

## On users and markets

**Users don't know what they want until they see it** – This idea, often associated with Steve Jobs, suggests that consumers are not a good source of ideas for innovation. However, user-centered design and need-seeker innovation strategy show that understanding or anticipating user needs can be a crucial driver of successful innovation.

**We can arouse people's needs** – Believing that we can arouse people's needs underestimates the complexity of human desires and overlooks the fact that true, lasting needs are often inherent or developed through personal experiences, rather than being easily created or influenced externally.

**True innovation does not need to study competition** – Understanding competitive landscapes can provide valuable insights for innovation, helping to identify gaps in the market, emerging trends, and potential areas for differentiation or improvement.

## On creative thinking

**Thinking outside the box is imperative** – Despite being sometimes beneficial, this is not the only pathway to innovation, and in many cases, deep understanding and working within existing frameworks can be equally, if not more, innovative.

**More Ideas mean better innovation** – It is often thought that the more ideas you generate, the more innovative you are. However, the quality and applicability of ideas are often more important than quantity.

**Innovation is only for creative types** – This misconception holds that only certain people with inherent creativity can innovate, whereas innovation can come from anyone, often through systematic methods and processes.

**Innovation cannot be at least partly automated** – Advancements in technology and data analytics are increasingly enabling automation in certain aspects of the innovation process.

# Do you have doubts, or are you tired of certain preconceived ideas about innovation?

## On the innovation process

**Managing innovation cannot be treated like any other business process** – While innovation does have unique challenges, applying structured business processes and management principles can effectively guide and support the innovation process, ensuring alignment with organizational goals and roadmaps, and efficient resource utilization.

**Most innovations are fortuitous, serendipitous or accidental** – Some innovations arise from resulting from unexpected connections or discoveries but most innovations are deliberate, and the result of intentional, structured and planned processes.

**Innovation is not linear** – Calling all innovation non-linear could lead to an over-emphasis on chaos and unpredictability, potentially overlooking the value of structured approaches and planning in the innovation process, or even justifying an organization's incompetence in organizing innovation processes.

**Innovation is unstructured and chaotic** – Some people think of innovation as a random, unstructured process. In reality, effective innovation often requires a structured approach, with clear goals and processes.

# The Radical Innovation Design manifesto

## Do you feel concerned?

**Shaping tomorrow's world is both an opportunity AND a responsibility.**

**Abusive innovation practices have clearly contributed to the social, environmental and economic situation we find ourselves in.**

**We cannot go on like this.**

**Let's focus on just the essential needs, but for these, let's be uncompromising.**

**Let's envision, as much as possible, and as early as possible, the added value of our innovations in usage contexts before going any further.**

**Let's always consider unresolved problems and expectations first, try to prioritize them, innovate from there without any preconceived idea that it will be impossible, then finally find a compromise between what creates progress value, and the overall cost of the solution and the company's interest and strategy.**

**Let's take into account not only user practices but also expert knowledge.**

**Let's design using a wide-angle approach.**

*"There are professions more harmful than industrial design, but only a few. Design, if it is to be ecologically responsible and socially responsive, must be revolutionary and radical. The only important thing about design is how it relates to people."*
***Victor Papanek, 1971***

**This will enable us to achieve our objectives in terms of usefulness, impact control and profitability.**

***SOURCE***
Papanek V., *Design for the real word – Human ecology and social change*, Academy Chicago Publishers, New York, 1971.

# Common pains and expectations when innovating

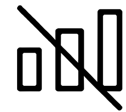
1. **Profusion of existing methods** and tools without knowing where and how to start

2. **Lack of knowledge** of the beneficiaries of our innovations, their activities and their day-to-day suffering and aspirations

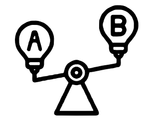
3. **Lack of tools** to take into account and process the vast amount of data that already exists

4. **Weak metrics** on which to base our decisions

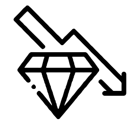
5. **Numerous** prototypes and tests with **little evaluation**



6. **Rare comparisons** of designed solutions with those already on the market




7. **Substantial investments** in projects with unproven value-creation potential



8. **Weak capitalization** on knowledge, issues and previous projects

9. **Exhaustion and demotivation** of teams

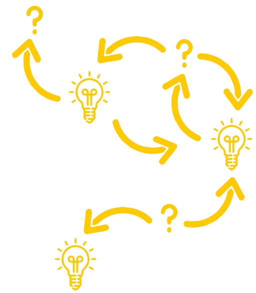
# Common innovator profiles

## Lost beginners

They are beginners, unfamiliar with innovation or change management methods and tools. They are simply lost when faced with the profusion of existing offers, don't know what to use and, above all, don't know where to start...

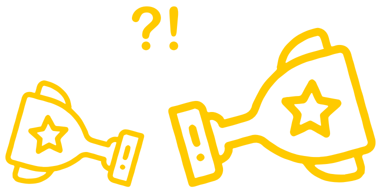
## Disillusioned regular shifters

These are the people who are familiar with innovation or change management methods and tools, who have met with great successes and, of course, bitter failures, and who now need to go further, to turn a corner, because they are confronted with certain recurring pitfalls of existing approaches.



## Unstructured one-off shifters

These are the people who have already implemented innovation or change management methods and tools from time to time, with varying degrees of success, and who are above all unstructured. They tinker, test, don't necessarily go all the way, and have now reached the limits of this very costly approach.




**Old leaders out of date**

These are the ex-leaders, those who succeeded in innovating and implementing an efficient change management strategy, but who never really knew why or how they achieved this success. Today, they are being overtaken by new entrants, often smaller and/ or more agile, who have less to lose in the development of disruptive offerings.

**Potential leaders in scaling up**

These are the ones with the wind in their sails, the ones with promise, the future high-potential executives. There aren't too many of them, but a few are asking for our help, because they know that they're growing fast and that this change of scale is not without consequences. It's a whole way of working that needs to be gradually transformed, and it's also an agility to act and design in a disruptive way that needs to be developed and sustained.

# Our value proposition

**Learning to innovate in an organized and modern way**, when needs are complex and diffuse, is the challenge of this eBook and its associated methodology and tools. The **Radical Innovation Design® (RID) methodology** was originally developed and taught at CentraleSupélec and marks a significant leap in innovative design processes:

- **Rigorous**, it requires defining the system on which you want to innovate. To achieve this, RID proposes to innovate on the perimeter of an existing *activity* to be improved or a new one to be developed.
- **Precise**, RID offers a comprehensive framework for expressing and understanding the multifaceted nature of design solutions in relation to specific user pains and expectations, user profiles, and situational contexts.
- **Tooled**, RID enables us to build a cognitive model of the target activity and use it as a simulator to analyze existing solutions on the market, as well as the value of the new innovative solution.
- **Quantitative**, it introduces an original *quantities of pain* metric that permits the calculation of *effectiveness* indicators to compare the ability of market solutions to be dominant under certain conditions, so as to determine an *innovation brief* in a data-driven manner.
- **Rational**, its algorithms calculate *value buckets* to qualify questions that need to be cracked during the ideation phase.

- **Systematic**, its ideation method exploits every nook and cranny of priority value buckets.
- **Modern**, the entire method is designed to rely on data to inform the decisions rather than instinct, with these decisions being documented and capitalized on throughout the project.
- **Practical**, RID fundamentally boosts the collaborative process between different stakeholders in the early stages of innovation, leading to shared understanding and collective, assumed decisions, for the specification of innovation briefs as well as for the selection of final ideas and designs. This ensures that new solutions are not only technically feasible, but also closely aligned with real-world requirements.
- **Research-oriented**, RID promotes integrated, informed decision-making rather than superficial understanding. Naming pains and expectations, quantifying them in real-life situations, and analyzing the causes of their shortcomings, enables us to put our finger on phenomena, which are themselves sources of invention once mastered. RID is also a way of driving research by need.

*"Design must be an innovative, highly creative, cross-disciplinary tool responsive to the needs of men. It must be more **research-oriented**, and we must stop defiling the earth itself with poorly-designed objects and structures"*

***Victor Papanek, 1971***

**SOURCE**

Papanek V., *Design for the real word – Human ecology and social change,* Academy Chicago Publishers, New York, 1971, ISBN: 978-0-89733-153-1.

# Our innovative solution

**Radical Innovation Design (RID)** is an **innovative, comprehensive, structured and traceable methodology of innovative design** that brings Design Thinking up to date.

Deliberately focused on **modelling usage situations and the user experience**, it attaches great importance to **problem setting**. A **cognitive model of the target activity** is built to capture the **effectiveness of current market solutions** on the **problems** encountered by the different **user categories** in **everyday situations**. From this, **algorithms** determine the most relevant **value buckets** from which to ideate. These are the ones that create the most **usefulness** in terms of usage, for which the solutions on the market are the least **effective**, and which correspond to the **company's strategy**.

RID enables systematic, usage-driven innovation to guarantee usefulness for users and profitability for companies, which are encouraged to move into areas where there is no competition.

RID differs fundamentally from methods based on the "fail fast" principle, by proposing a **single process ensuring traceability of reasoning** with a total of **seven original methods**, adapted **algorithms and vizualisation tools**, a **metric of "quantities of pain"** and two **decision-support indicators** (effectiveness and value buckets). RID is the **first computerized methodology** to implement and secure usage-driven innovation processes, and is particularly **well suited to cases where usages are complex or diffuse**. It has been applied and validated in multiple industrial and commercial sectors.

# Our innovative solution

## KNOW AND TARGET THE MARKET(S) FOR YOUR SOLUTION

**Define the target activity and observe** (organize your investigation and collect deep knowledge)

**Enrich your understanding of beneficiaries** (pains and expectations, users and key stakeholders, usage situations)

**Compare existing solutions** (characterize precisely the strengths of your competitors' products, in the eyes of your users)

**Decide which values are worth developing**

**Specify the innovation brief** of your solution

**Ideate from the values targeted**

## DESIGN A NEW SOLUTION ARCHITECTURE AND ITS BUSINESS MODEL

Assess ideas & concepts maturity

Explore solution architectures

Explore business models

Assess and validate the value creation gain of your solution and its competitive advantages

## OTHER SKILLS TO DEVELOP BY TRAINING AND CERTIFICATION

Learn and quickly put into practice RID through use

Understand and initiate the implementation to one of your projects

Master and integrate into your innovation processes

# Readership

This eBook contains 161 methodological sheets. You can follow 3 different journeys to move from sheet to sheet, or follow the internal links between the sheets, while benefiting from external links to complementary resources. The fact sheets highlight the depth of the new concepts presented, through numerous illustrations and real-life projects.

This manual is aimed at three types of reader:

1. **Professionals not trained in innovation**, who are convinced that effectively improving some user activities is the ultimate goal, even if one starts with technology, so as to create value for their users and increase profitability for their company.

**Recommended journey:**

**Discovery**

2. **Students who are learning how to manage innovation projects**, who are looking for principles and methods to innovate products, services and organizations, and who would like to start from an ambitious base to innovate in a way that is both useful for users and profitable for the company in the modern age of information processing.


**Recommended journey:**

**Discovery** then **Exploration**

3. **Innovation professionals, such as Design Thinking (DT)** practitioners, who have acquired the reflexes and mastered the basic tools and processes of user-centred design and who would like to go beyond DT with a more systematic and equipped approach to exploring opportunities for value creation.

**Recommended journey:**

**All!**

# Format

## The journeys

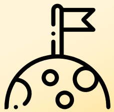
This eBook contains 161 fact sheets, making a total of around 380 pages. You can browse through these sheets following 3 different journeys:

1. **Discovery journey**: you are new to the RID methodology and/or innovation and would like to discover the main key concepts.

32 fact sheets presenting this icon

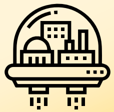
2. **Exploration journey**: you are familiar with the RID methodology and would like to apply it to a simple case.

83 fact sheets presenting this icon



3. **Complete journey**: you wish to acquire all the RID expertise.

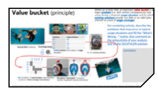
Read all the fact sheets and get ready to experience RID by yourself!



## The links

The beauty of an eBook is that there are lots of links to explore:

- Each fact sheet gives you access to several others via **internal links.** You can surf these internal links.
- A scientific reference generally gives you access to **full-text scientific articles**.
- Click and watch **videos**!
- You may download **RID Micro tools and templates** to use them in your projects.
- You may download the **RID Serious Game**, print it, and try discover the main RID concepts by the game.
- An **exercise booklet** can be downloaded along with the **solutions**.
- **5 RID studies** can be downloaded to observe a study in its entirety





### The eBook's editorial principle

The book's aims at **simplicity**, but also highlighs the **depth of the (new) concepts** presented, through numerous **illustrations** and **real-life projects** (one industrial project is used as a common thread throughout the book and a second one is used at the beginning of the book as a popular overview).

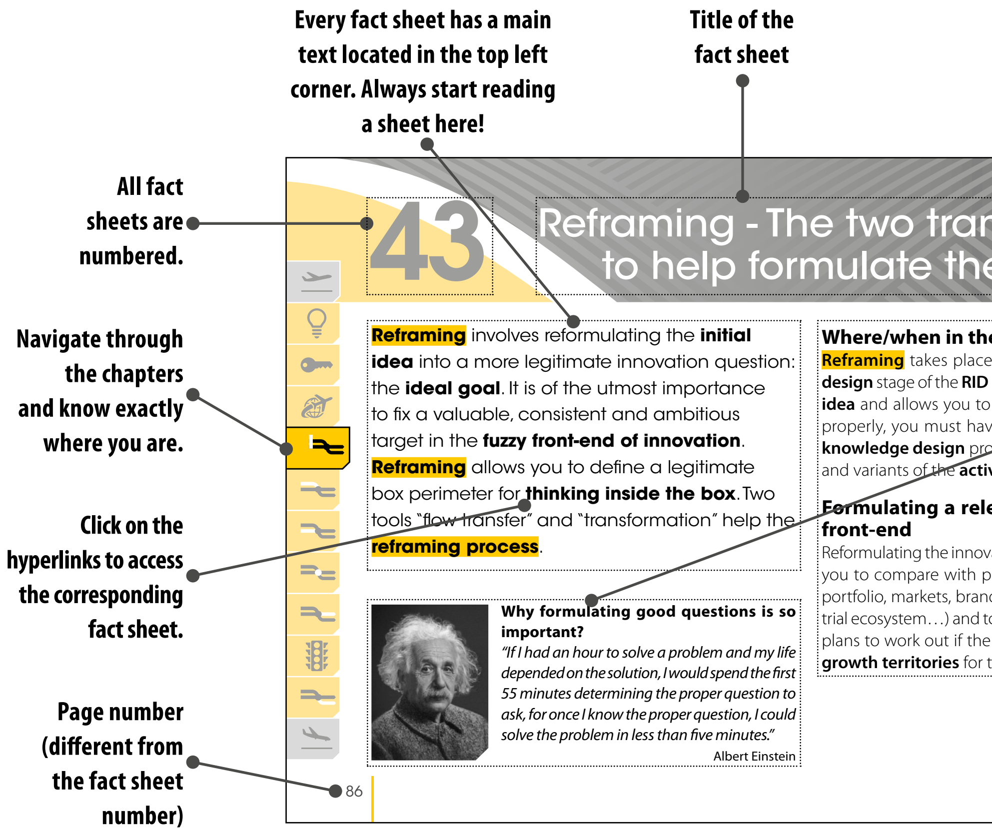
# How to read the eBook?

This eBook is designed to be read as a double-page spread. It is divided in sections. Each section contains several fact sheets. Most of the fact sheets occupy a double page.

You can read the book chapter by chapter, or by journey (selection of fact sheets associated to a difficulty level), or simply by jumping from one concept to another thanks to the hyperlinks! At any time while browsing, you can return to the last consulted fact sheet using the keyboard shortcut:

*alt* ◀

*cmd* ◀ (Mac)



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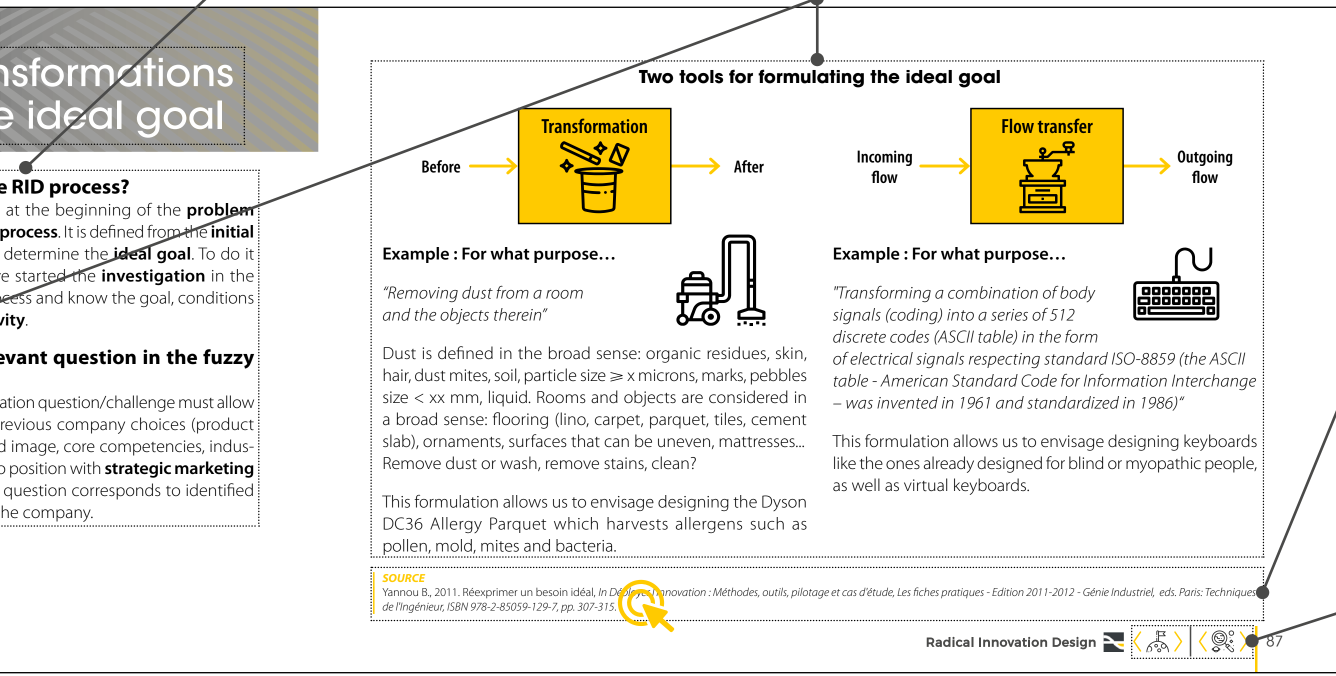
**Some fact sheets have a secondary text providing more details.**

**All fact sheets provide more contents, that vary in nature: illustrations, examples, quotations, diagrams…**

**Click on hyperlinks to access either another fact sheet, or an external resource (web page or content to download).**



nsformations
e ideal goal

**e RID process?**

at the beginning of the **problem** **process**. It is defined from the **initial** determine the **ideal goal**. To do it e started the **investigation** in the cess and know the goal, conditions **vity**.

**evant question in the fuzzy**

ation question/challenge must allow revious company choices (product d image, core competencies, indus- o position with **strategic marketing** question corresponds to identified he company.

**Two tools for formulating the ideal goal**

Before → Transformation → After

Incoming flow → Flow transfer → Outgoing flow

**Example : For what purpose…**

*"Removing dust from a room and the objects therein"*

Dust is defined in the broad sense: organic residues, skin, hair, dust mites, soil, particle size ⩾ x microns, marks, pebbles size < xx mm, liquid. Rooms and objects are considered in a broad sense: flooring (lino, carpet, parquet, tiles, cement slab), ornaments, surfaces that can be uneven, mattresses... Remove dust or wash, remove stains, clean?

This formulation allows us to envisage designing the Dyson DC36 Allergy Parquet which harvests allergens such as pollen, mold, mites and bacteria.

**Example : For what purpose…**

*"Transforming a combination of body signals (coding) into a series of 512 discrete codes (ASCII table) in the form of electrical signals respecting standard ISO-8859 (the ASCII table - American Standard Code for Information Interchange – was invented in 1961 and standardized in 1986)"*

This formulation allows us to envisage designing keyboards like the ones already designed for blind or myopathic people, as well as virtual keyboards.

SOURCE

Yannou B., 2011. Réexprimer un besoin idéal, *In Déployer l'innovation : Méthodes, outils, pilotage et cas d'étude, Les fiches pratiques - Edition 2011-2012 - Génie Industriel, eds. Paris: Techniques de l'Ingénieur, ISBN 978-2-85059-129-7, pp. 307-315.*

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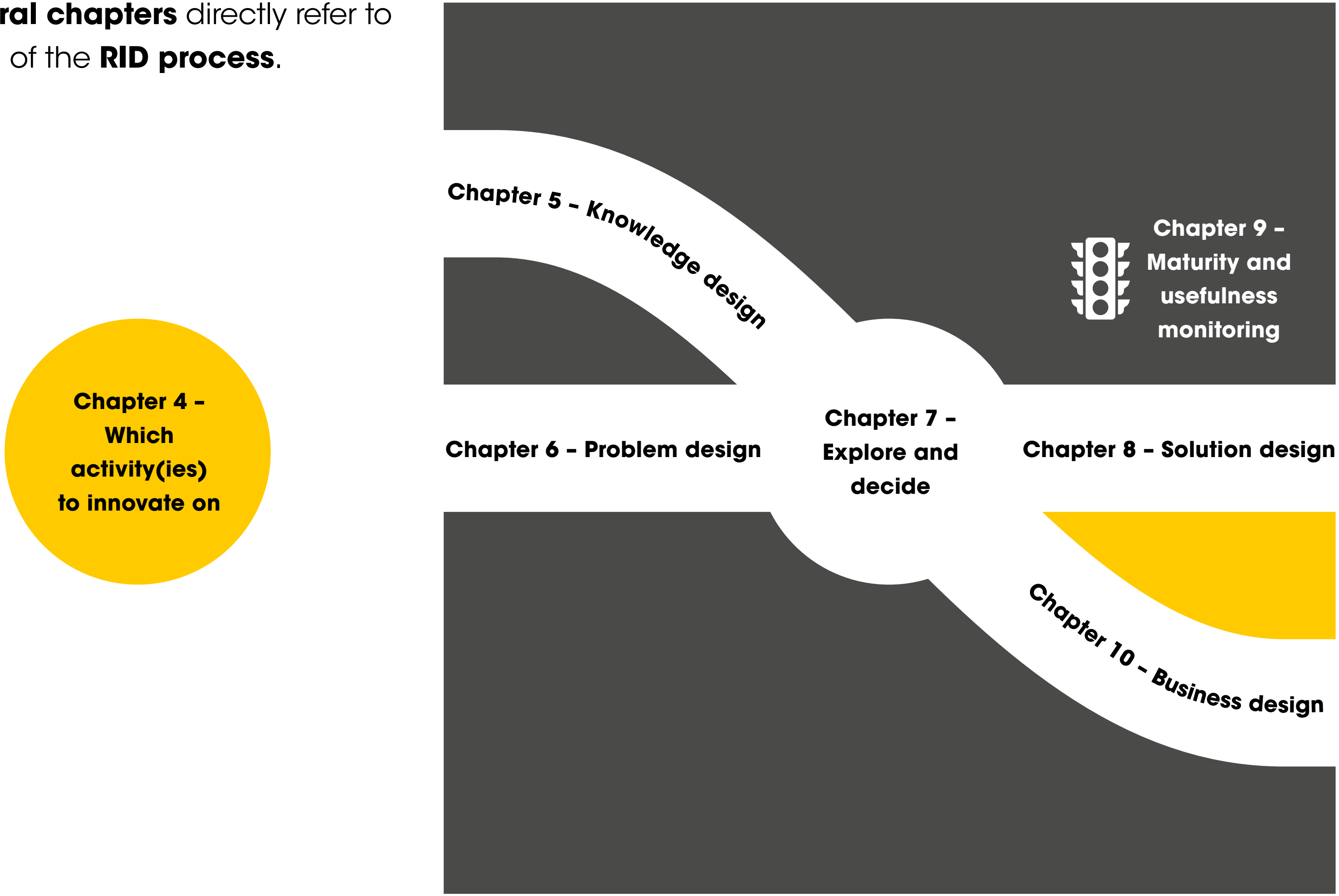
**When relevant, all sources are listed in the bottom righ-hand corner of the fact sheet. You can access most of the sources on the internet by clicking on the hyperlink.**

**If the fact sheet is part of the Discovery or Exploration trail, navigate easily to the previous or next fact sheet of the trail.**

# Table of contents

**Several chapters** directly refer to parts of the **RID process**.



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# The authors: Bernard Yannou

## My background

I am a Distinguished Professor in Innovative Design for Engineers, covering the fields of engineering design, innovation management, and R&D management.

The prisms frequently used in my domain are those of:

- Analysis and expression of needs in a form that can be interpreted by designers,
- Innovative design processes (of the Design Thinking type or, more industrial, Stage & Gate® types),
- Performance simulation tools,
- Techniques for managing complex projects, of concurrent engineering, of modular / robust / inclusive design, and numerical techniques for multidisciplinary and robust optimization.

I am also very interested in the range of approaches to assessing value in the eyes of customers or users and in approaches to the analysis and design of complex systems.

## My motto

***"To make myself useful through the proposal of innovative design methods that enable us to invent desirable new worlds."***

## My observations

In my career, I have often observed major shortcomings in the design practices of innovative systems. Firstly, user expectations are poorly formalized and are almost always averaged, with the different contexts of use often being aggregated. An intelligent approach to user segmentation and a simplified representation of existing and ideal activities were therefore needed. I also found that innovative design methods offered no way of knowing (i) whether it was still possible or desirable to make a little or a lot of progress in an area of innovation, nor (ii) how to define from the outset a competitive innovation positioning in relation to the competitors' existing innovative solutions. My aim was therefore to propose tools for visual analysis of the problem and expectations, as well as for monitoring the design of user value.

**Bernard YANNOU**

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## Bio

Bernard Yannou is an alumnus of the École Normale Supérieure de Paris-Saclay, with a degree in mechanical engineering. He obtained his doctorate in 1994 on the subject of the automation of systems design at Dassault Systèmes. His research work led him to obtain his *Habilitation à Diriger des Recherches* in 2001, with a thesis on the phases and conditions of the preliminary design of complex systems.

Bernard Yannou is now a Distinguished Professor in the design (and innovation) of complex systems. He heads the Industrial Engineering Research Department at CentraleSupélec (CS), founding member of University Paris-Saclay. He is also deputy director of research at CS, in charge of deeptech entrepreneurship.

In teaching, he has taught courses in 'Design Science', 'Radical Innovation' and 'Management of R&D and Innovation'. He created the final-year minor "Design and Industrialization of Innovative Systems" at CS, and the MS in Complex Systems Engineering at University Paris-Saclay.

In research, he has supervised more than 35 doctoral theses, most of them in industrial contexts. He is the author or co-author of more than 400 peer-reviewed articles, including 90 journal articles. He has also coordinated 10 books on design and innovation of industrial products.

He is the inventor of the Radical Innovation Design® methodology, and he co-founded HyB'RID for which he is Chief Research and Strategy Officer.

# The authors: François Cluzel

## My background

I am a researcher in engineering design, particularly looking at innovative and sustainable dimensions.

To design is, in Herbert Simon's words, to draw up action plans aimed at transforming existing situations into preferred ones; and products and services are, therefore, only useful in these situations. Their use provokes changes and impacts multiple stakeholders and the environment.

As a researcher in product design, I aim to assist industrial organizations and inspire designers to rationally develop products with the best possible impact, namely maximizing usefulness for well-defined beneficiaries while minimizing negative consequences. It means that these products and services must be designed on their entire life cycle (including possible usages) with respect to the planetary boundaries and by taking great care of social implications.

I have developed models, processes, methods, and tools to allow the transition of organizations designing such products and services by questioning the needs, assessing and improving their environmental performance through circular economy strategies. These research objects are designed to be useful for and usable by their users (the product designers!).

## My motto

***"To assist people designing engineered artefacts for human activities by maximizing usefulness and sustainability!"***

## My observations

Most companies designing and delivering products and services still fail to consider multiple dimensions (beyond very technical and economic performance) at the early stages of the design process. The notion of value is often restricted to money and rarely encompasses user-centric, social, societal and environmental considerations. In an innovation process, instead of thinking outside the box with no predefined constraints, there is an urgent need to re-think inside the boundaries required to draft desirable futures. It will ensure the (re-)design of useful and sustainable products and services.

## François CLUZEL

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## Bio

François Cluzel is an assistant professor and head of the Design Engineering research group in the Industrial Engineering Research Department at CentraleSupélec, University Paris-Saclay. He holds a PhD in industrial engineering from Ecole Centrale Paris (2012), a master's degree in industrial engineering from Ecole Centrale Paris (2008) and a mechanical engineering degree from Supméca Paris (2008). He is a member of the Design Society and the French network of eco-design researchers EcoSD. His research and teaching projects deal with innovation engineering and circular economy. In teaching, he created the final-year specialization "Design & System Sciences" at CentraleSupélec, where he teaches engineering design. He also created several courses on circular economy, eco-design and industrial ecology. He has taught Radical Innovation Design® methodology since 2008 and has coached numerous RID student projects with industrial partners. He has co-supervised 8 PhD theses, most of them in industrial contexts. He has authored or co-authored 24 peer-reviewed journal articles.
Since 2008, he has collaborated with Bernard Yannou in developing the Radical Innovation Design® methodology. He is a founding partner of the start-up HyB'RID, founded in 2018, and he is currently the company's Chief Operation Officer.

# Acknowledgements

## Special thanks to ...


### ... people who contributed to inspire this work

Alexandre Bekhradi, Benjamin Zimmer, Claudia Eckert, Emilie Vallet, Flore Vallet, Guillaume Lamé, Jean-Sébastien Gros, Lucile Picon, Marija Jankovic, Michele Gatti, Olivier Feingold, Patrick Ternier, Pierre Talbot, Robin Lecomte, Romain Farel, Roman Weil, Thierry Devèze, Tom Formont, Yiming Ma

### ... long-standing collaborators in tutorial supervision

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**... you, for your patience and love**

Gwenola and Elena

# Chapter 1

## The need for a new innovation methodology

# 01 What is innovation?

**Innovation** is both a process and an outcome, in which **something new** is **created** that brings **value** to particular **people**.

**Innovation** is considered synonymous with **design** when of novelty factor is high.

**Creating / Designing** – One should be able to use a process, tools, methods and even **methodologies** to converge towards a satisfactory **outcome**, starting from the situation actually experienced by people.

**Something** – How to represent, name, or describe the **outcome** of an **innovation** process? Are the different **innovation** outcomes of different nature and, if so, do we need to use a different creation/design methods, depending on the nature of the expected outcome?

**New** – To appreciate that something is novel, one must use models to characterize the nature of the **innovation** and metrics to measure the **intensity of the innovation**. You must also ensure that this **newness** is desired and desirable.

**Value** – **Newness** is not enough to guarantee value. How do you assess that this **newness** could improve something?

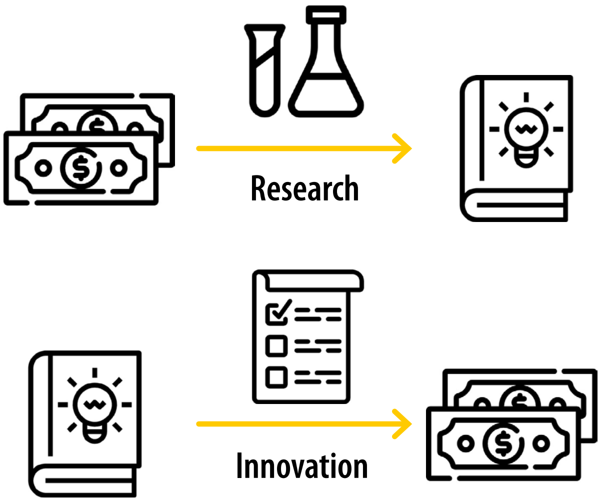
**People** – Value created by an **innovation** may be beneficial to users, customers, company development, company employees, company shareholders, investors, existing value chain actors, nations…

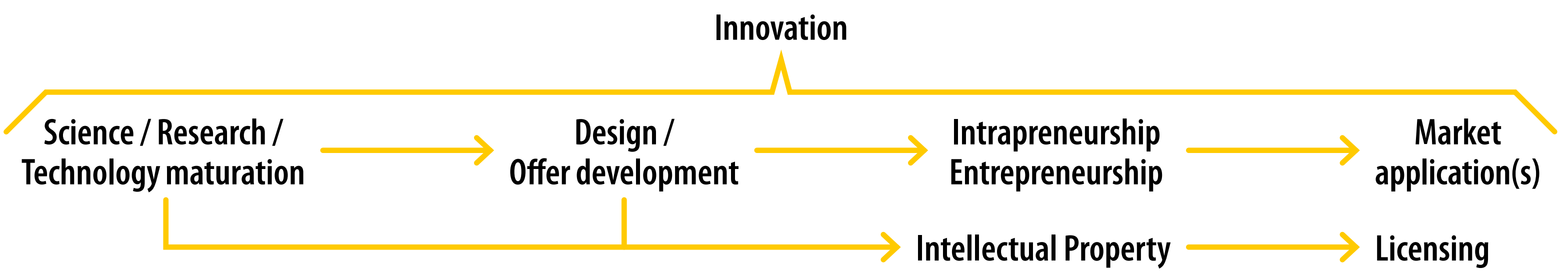
## Need for a new innovation methodology

- **Solution representation**: Represent the outcome of an innovation process
- **Universality**: Get a universal innovation process or methodology whatever the nature of the resulting innovation outcome
- **Newness appraisal**: Appraise the newness of the outcome
- **Value measurement**: Measure the value brought to people
- **User categorization and prioritization**: Identify the categories of people that you want to serve as a priority

# 02 Innovation process

**Innovation** is a **process** led by a multidisciplinary team of innovators and designers. This process navigates betwen a universe of creativity and spontaneity, and a universe of organisation and rationality. In companies, it may be seen as opposed to research activity. More generally, the **innovation process** encompasses the R&T, design / development and **business design** processes. To be correctly operated, it requires an **innovation methodology**.



An **innovation process** must be organized by (1) the multidisciplinary nature of design, the need to articulate different designer cultures and representations and (2) the necessity to plan the tasks so as to **explore and exploit** satisfactorily. In addition, it must preserve and even favor the human and artistic part of innovative design, i.e. (1) creativity (2) deep understanding of users (3) group cohesion and synergy.

**Innovation process** is often seen as opposed to research process in companies. Innovation transforms Knowledge into Profits whereas Research uses Money to generate Knowledge. Even if this schema is globally correct, it should be noted that some knowledge is also generated during **innovation process** (see **knowledge design** and **exploration-exploitation**) that can lead to Intellectual Property and licensing per se.

## Reconciling two universes

| **Organization and rationality** | **Creativity and spontaneity** |
|---|---|
| Deduction, Induction | Abduction, Inspiration, Intuition |
| Design development | Creativity, Ideation |
| Team working | Invention |
| Launch & Communication | Observation, usage |
| Funding | Emotions, perceptions, interactions |
| Testing, experimentation & validation | Empathy, Human-Centered Design |
| Project planning | Wow effect |
| Cost management | |


*SOURCE*
Lamé G., Yannou B., Cluzel F., 2018. Analyzing RID methodology through the lens of innovative abduction, In *Int. Design Conf.*, May 21-24, Dubrovnik, Croatia.
Luo J., 2015. The united innovation process: Integrating science, design, and entrepreneurship as sub-processes. *Design Science*, 1, E2.

# 03 The need for innovation methodologies

An **innovation process** needs an **innovation methodology** to produce a satisfactory outcome with a multidisciplinary group. Most of the time, an **innovation methodology** is made up of a philosophical and linguistic part (**constructs or language, principles, values**), a **process** part, some structuring **methods** and elementary **tools**. Sometimes **theory** is preferred to methodology when experimentation does not easily validate the methodology's effectiveness or when it is more descriptive than prescriptive.

***"There is need of a method for finding out the truth."***

*"In ourselves we notice that while it is the understanding alone which is capable of knowing, it yet is either helped or hindered by three other faculties, namely imagination, sense and memory. We must therefore examine these faculties in order, with a view to finding out where each may prove to be an impediment, so that we may be on our guard; or where it may profit us, so that we may use to the full the resources of these powers."*

René Descartes, 1626–1628. *Regulae ad directionem ingenii (Rules for the Direction of the Mind).* http://dt.pepperdine.edu/descartes-rules-for-direction-of-the-mind.html

**Does your innovation methodology support the necessary cognitive tasks and reasoning modes of innovation practice?**

## ➔ Cognitive tasks

Innovative design is, first, a practice, not always an organized process. Whatever the process, innovative design activity involves a set of indispensable **cognitive tasks** (see figure).

But how to organize these tasks?

- With different designer expertises
- When the innovation outcome concerns a variety of users/customers
- In time and resources, for the process to be effective and efficient

The answer is to have a common methodology, i.e. a common philosophy and language (constructs/concepts, principles, values), a common project breakdown (process), and common structuring methods and elementary tools.

## ➔ Cognitive reasoning modes

Innovative design can use the four human cognitive reasoning modes: deduction, induction, selective abduction, innovative abduction.

RID methodology has shown it can re-balance deduction reasoning in the preliminary problem setting stage where data collected from users' activities should be more processed and analyzed.

**Example of a simple innovation methodology**



*SOURCE*

Lamé G., Yannou B., Cluzel F., 2018. Analyzing RID methodology through the lens of innovative abduction, In *Int. Design Conf.*, May 21-24, Dubrovnik, Croatia.

Yannou B., Jankovic M., Leroy Y., and Okudan Kremer G. E., 2013. Observations from Radical Innovation Projects Considering the Company Context, *Journal of Mechanical Design*, 135(2).

# 04 Innovation methodologies have their own language

Read carefully the definitions of the **main innovation methodologies**, and observe how much they have their **own language**, i.e. their unique way to describe the world.

**Design Thinking** is the most popular innovation approach. It is not exactly a methodology (no strong concepts) but it is structured by clear innovation principles - as **human-centered-design, ethnographic practices, empathy, fail fast and iterations -** a **simple design process** and a rich toolbox of tools and methods.

***Key reference:***
Brown T., 2008. Design Thinking. Harvard Business Review 86:84–92.

**CK Theory** (for Concept-Knowledge) is not a methodology but a **theory of design reasoning**. It opens a space of reflection, whose architecture is regulated by set theory, starting from a **concept** with associated features that will induce gaps in the **knowledge space**. The increase in knowledge will in turn allow the creation of new concepts. This is a **management theory** that is intended to be inserted into the company's processes.

***Key reference:***
Le Masson P., Weil B., Hatchuel A., 2006. Les processus d'innovation: Conception innovante et croissance des entreprises, Hermes Science Publications, ISBN: 978-2746213661.

**TRIZ** (in Russian, Theory of Inventive Problem Solving) is a **heuristic approach to solving innovation problems,** mainly technical ones. Based on the search for **domain-independent inventive mechanisms in patents**, as well as on the **properties of regulation and evolution of technical systems**, its tools allow designers to explore generic solutions, close to the initial solution, and to stimulate the **search for innovative concepts by analogy** with these generic solutions.

***Key reference:***
Savransky S.D., 2000. Engineering of creativity - Introduction to TRIZ Methodology of Inventive Problem Solving, CRC Press, ISBN: 978-0849322556.

**Lean startup** is a methodology for **developing businesses and products** that aims to **shorten product development cycles** and rapidly discover if a proposed **business model is viable**; this is achieved by adopting a **combination of business-hypothesis-driven experimentation, iterative product releases, and validated learning**. Lean startup emphasizes customer feedback over intuition and flexibility over planning. This methodology enables recovery from failures more often than traditional ways of product development.

***Key reference:***
Ries, E., 2011. The Lean Startup, Crown Business, New-York, ISBN: 978-2744065088.

# 04 Innovation methodologies have their own language

**Blue Ocean Strategy** is a **theory of innovation marketing** (made of templates and **guiding strategies**) which focuses on what would **make an offer competitive**, while unlocking new demand and making the competition irrelevant. It prompts an organization to systematically **create and capture "blue oceans"**, i.e. **unexplored new market areas**, while **lowering cost** by **simplifying the product features** but at the same time putting the emphasis on a **limited number of innovative features**.

***Key reference:***
Kim C.W., Mauborgne R., 2005. Blue ocean strategy - How to create uncontested market space and make the competition irrelevant, Boston, USA/MA: Harvard Business School press, ISBN: 978-1591396192.

**Business Model Canvas** is a **strategic management template and method** used for **developing new business models and documenting existing ones**. A business model describes the rationale of how an organization intends to create, capture and deliver value. It offers a visual chart with nine "building blocks" **describing a firm's or product's value proposition, infrastructure, customers, and finances, assisting businesses to align their activities by illustrating potential trade-offs**. The BMC is better suited to innovate on the business model than on the value proposition itself.

***Key reference:***
Osterwalder A., Pigneur Y., 2010. Business Model Generation, Hoboken, New Jersey: John Wiley & Sons, Inc, ISBN: 978-81-265-3367-1.
Osterwalder A., Pigneur Y., Bernarda G., Smith A., Papadakos P., 2014. Value Proposition Design, Hoboken, New Jersey: John Wiley & Sons, Inc, ISBN: 978-1118968055.

## Radical Innovation Design

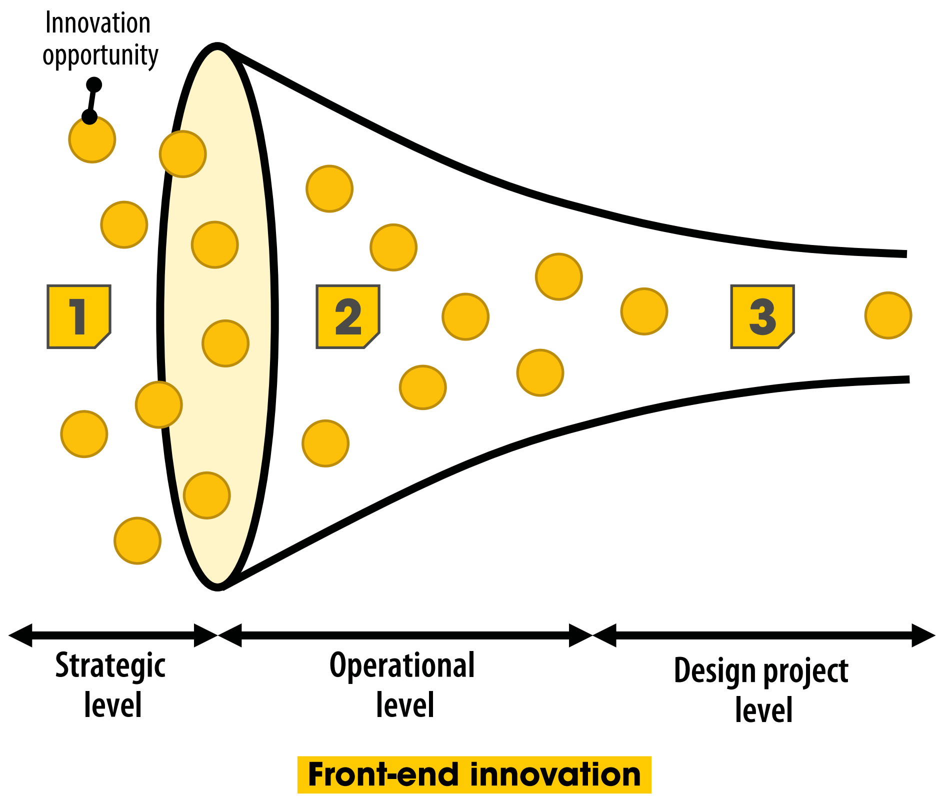
Beyond Design Thinking, RID is a novel, complete and well-structured innovative design methodology that prioritizes the **improvement of the user experience** within a **field of activity**. It is deliberately **usage driven and activity centered**. RID guides innovators who want to **systematically explore users' problems and unstated needs**, and evaluating which ones are most pressing in terms of innovation, taking into account the **effectiveness of existing solutions**. RID revolutionizes the way to define innovation targets along with its unique concept of **ambition perimeter, composed of selected value buckets in adequacy with company strategy**. With its emphasis on **problem exploration**, project management and **decision-making frameworks**, its ability to **measure quantities of pains to prioritize innovation leads and assess solution usefulness**, its **traceability** and reporting facilities, RID differs from methods based on early quick and dirty prototyping. It is the first **computerized methodology** to implement usage-driven innovation processes and it has now been validated in various industrial and business sectors.

***Key reference:***

Lecomte, R., & Yannou, B. (2024). RID journal paper - RID study Falls of the elderly (Version V1).

# 05 The front-end innovation

**Front-end innovation** evokes the preliminary period where you explore opportunities for innovation and where creativity is intensively used to imagine breakthroughs in the way you usually create value for your customers. Often, one speaks of **fuzzy front-end innovation** to underline that creativity is the governing factor and that this period ends with the start of a more formal or linear design and development process.



This concept can take different forms in companies:

1 **At a high strategic level**, the strategic marketing service analyzes market and technology trends to identify and proritize growth territories for the company (areas where it is strategically interesting to innovate).

2 **At a more operational level**, the operational marketing service or a product line manager can decide that it is opportunistic to propose a renewed or brand-new value proposition to a given customer segment. Then, a marketing brief is drawn up that serves to start a development project.

At a third level, **once a design project has started**, if the 3 marketing brief or initial specifications are not too constraining, then there is still sometimes the place for some ideation sessions to complete the value proposition description or the technical solution.

## Need for a new innovation methodology

**Integration of the front-end innovation within the development project:**

**Front-end innovation** is often poorly defined or absent in the innovation processes and methodologies proposed in the literature, which means that these crucial exploratory phases of breakthrough problems, ideas, projects are still poorly formalized and tooled.

There is a need to integrate this **front-end innovation** within the development project, so as to optimize as a whole the opportunities' identification and development.

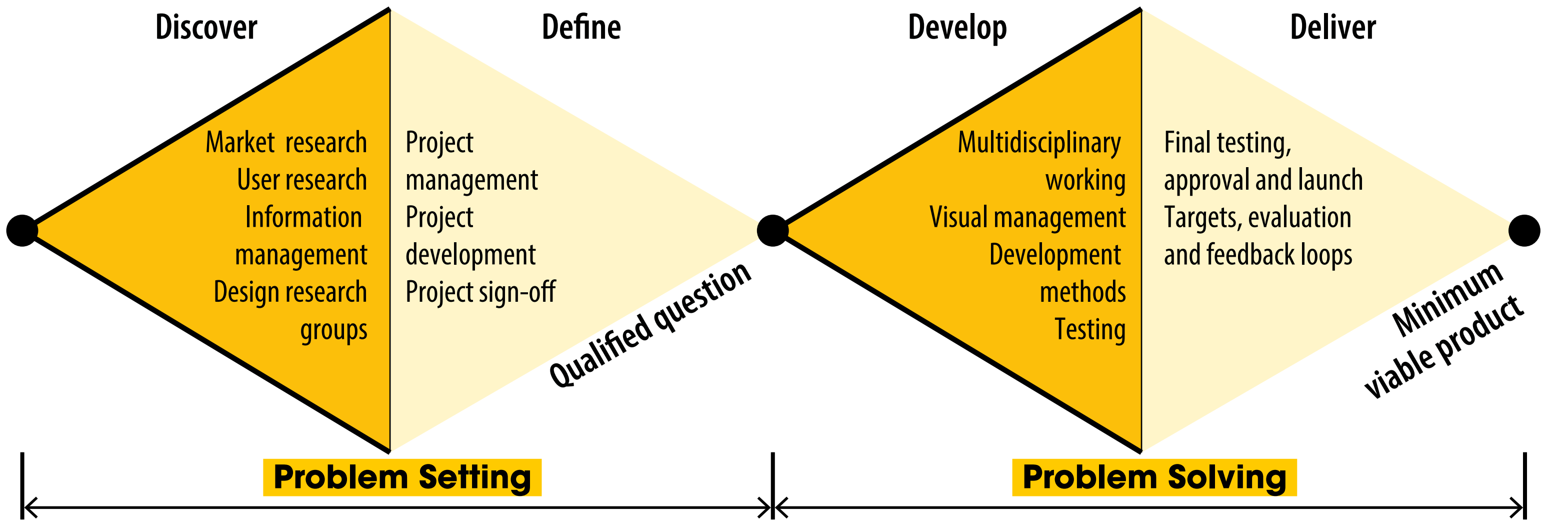
***SOURCE***

Bertoluci G., Yannou B., Attias D., Vallet E., 2013. *A categorization of innovation funnels of companies as a way to better make conscious agility and permeability of innovation processes*, In ICORD: 4th International Conference on Research into Design, January 7-9, Chennai, India.

# The importance of chaining Problem Setting and Problem Solving

## The Double-Diamond process

While many authors see the **innovation process** as a **problem-solution co-evolution**, few have suggested a clear transition from one to the other during the innovation project by advocating as complete an **exploration** of the problem as possible. However, this is the case with the **Double Diamond design process**, created in 2005 by the UK Design Council.



Each diamond evokes a cognitive **divergence-convergence** sequence. The first diamond leads to the formulation of a set of **qualified questions** that feature the relevant problems to innovate on (see also **ambition perimeter**) and which traditionally corresponds to the **project specification** or **design/marketing** brief. A qualified question is a precise issue that should be solved with the promise of bringing value to the target group. The second diamond leads to the general description of the value **value proposition**, called **Minimum Viable Product (MVP)**.

## Need for a new innovation methodology

- **Enhanced Problem Setting**: As much importance must be given to the **problem setting** as to its solving
- **Traceability and revisability**: We should keep track of the exploration of the **problem setting** and of the **problem solving**, so as to be able to feedback, first on the choice of the MVP, second on the choice of the qualified questions if the MVP innovation outcome still remains unsatisfactory.
- **Qualified questions**: one should be able to have a grammar to express them and a more systematic method to enumerate them.
- **Value measurement**: One should be able to objectively measure the potential value contained in the qualified questions and the resulting value delivered in the final MVP.
- **Ideation reference frameworks and tools**: There are two ideation periods at the left parts of the two diamonds (1) when one starts from nothing, (2) when one starts from qualified questions. In both cases, one needs ideation reference frameworks to figure out where to go, as well as tools for diverging/ideating.

*SOURCE*
See UK Design Council website

# 07 Design Thinking

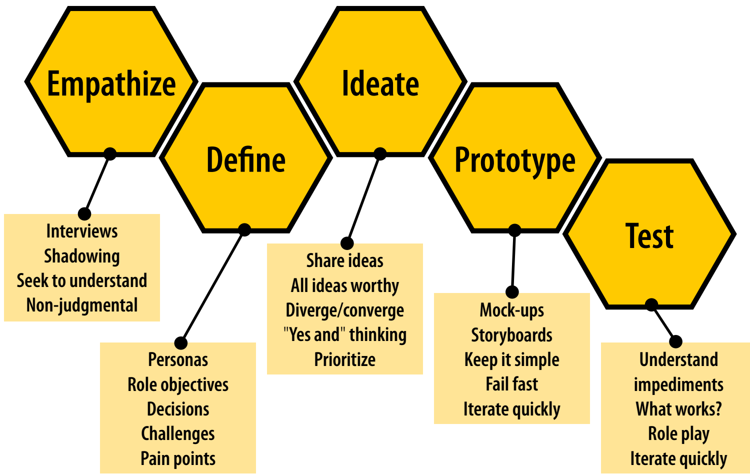
## A process or an approach?

**Design Thinking** (DT) is an approach invented in California for the IT sector. The **DT** process was developed in the 1980s by Rolf Faste at Stanford University. It was popularized in the 2000s by IDEO under the leadership of Tim Brown. Since the 2000s, **DT** has democratized design in companies. It provides a clear design process and attitudes for all. The main principles of **Design Thinking** are:

- user-centered innovation
- empathy
- field study (ethnographic observation)
- UX design
- first value is desirability
- iterations, feedback loops
- fail fast
- co-design and collective intelligence

Since the 2000s, **DT** has popularized design processes, attitudes and thinking everywhere, which is much positive. However, some limits have been highlighted by experts and practitioners (see next page).

**Design Thinking Process**
**(adapted from https://dschool.stanford.edu/)**



## Need for a new innovation methodology
(this only commits the authors)

**To keep from Design Thinking**

- **Ethnographic approaches** (field study, empathy, experimentations)
- **User-centered and co-design processes**

**To augment**

- **Knowledge about people and phenomena**: *UX design* must be deepened with ergonomics, psychology, medicine, sociology, activity theory… and any science that can allow to study and understand short-medium-long terms values or non-values for people.

**To reject from Design Thinking**

- **Process dynamics**: The systematic *fail fast and iterations* paradigm is more adapted to rich US states than to more sober European industrialist living in economic crisis. A rich and organized exploration of the problem setting stage naturally strongly limits the posterior feedbacks.
- **Highest Value**: *Desirability* is the highest value for DT. It is often in practice (for innovators) synonymous to a personal envy to suddenly buy and consume. Other values should now govern the search for innovation in a world suffering from too much vain consumption.

In practice, there exists a **collection of tools** under each **Design Thinking** stage. Some of them are easily accessible on the internet:

- Resources from the d.school at Stanford University
- 20 Best Online Tools for Design Thinking by SessionLab
- Design Kit by IDEO.org
- Design Sprints by Google
- The Venture Design Process by Alexander Cowan

Some tools or methods have been developed independently of Design Thinking, but are often used during a **Design Thinking** approach or project, like:

- Empathy card
- **Persona method**
- **Customer Journey Map**
- …

*SOURCE*

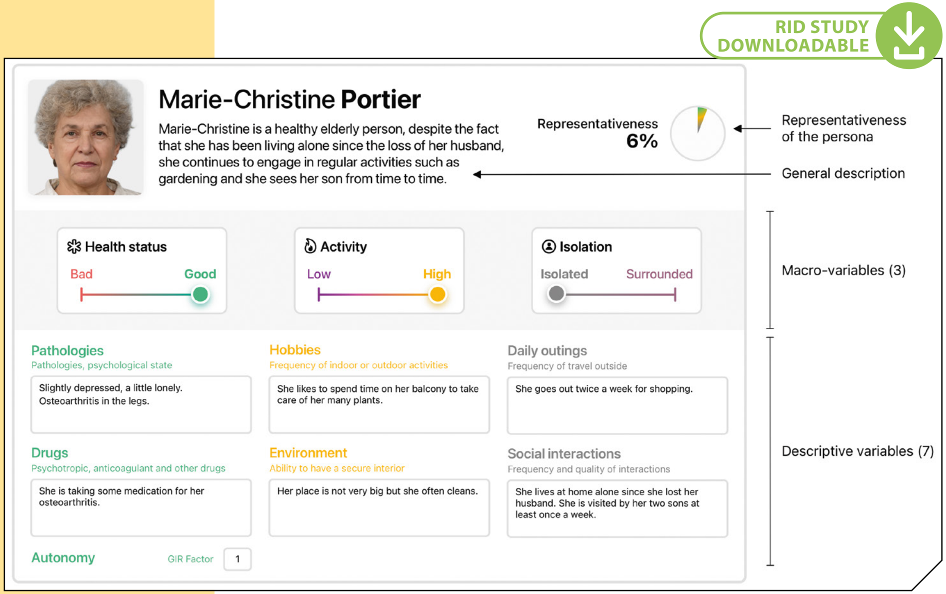
Brown, T. (2008). Design Thinking. Harvard Business Review, 86, 84–92.

## Tool #1: Persona method

**A persona** is a **fictional user model** often used by marketing and design teams to feature archetypal customer or user categories [Cooper, 1999].

A set of **personas** is usually defined to fit the context of an innovation project and serves as a shared basis to understand, design and communicate [Grudin & Pruitt, 2002]. It is also used in policy making to design services for the population [Gonzalez de Heredia et al., 2018]. Each **persona** is defined through an identity card whose attributes are in general: gender, age, profession, hobbies, location and lifestyle, consumption style, key values, personality traits, motivation, goals, etc.

**Several authors note a potential lack of solid empirical grounding to generate personas and narrate their lives [Miaskiewicz & Kozar, 2011]. Others have proposed methods to learn from statistical data [Stevenson & Mattson, 2019] and build coherent use scenarios [Vallet et al, 2020].**




# Need for a new innovation methodology

## User – People – Beneficiary representation

- Avoid enouncing arbitrary **persona** categories, but to prefer extract them from solid field observations and statistical studies
- Avoid featuring precise **persona** characters but prefer to define user classes with traits defined by ranges
- Sometimes, innovation issues do not consist in creating value for categories of people but for a system, a component, a territory, the planet. In this case, keep defining **persona** IDs for featuring categories for these beneficiaries.


***SOURCE***

Cooper, A. (1999). The inmates are running the asylum: Why Hi-tech Products Drive Us Crazy and How to Restore the Sanity. Indinapolis, USA: Macmillan Publishing Co. ISBN: 978-0672316494.
Gonzalez de Heredia A., Goodman-Deane J., Waller S., Clarkson P. J., Justel D., Iriarte I., & Hernández J., 2018. Personas for policy-making and healthcare design. In *Proceedings of the DESIGN 2018*, Dubrovnik, Crotia.
Grudin J., & Pruitt J., 2002. Personas, Participatory Design and Product Development: An Infrastructure for Engagement. in *Proceedings of Participation and Design Conference (PDC2002)*, Sweden.
Lecomte, R., & Yannou, B. (2024). RID journal paper - RID study Falls of the elderly (Version V1). Zenodo.
Miaskiewicz T., & Kozar K. A., 2011. Personas and user-centered design: How can personas benefit product design processes?, *Design Studies*, 32(5), 417-430.
Stevenson P., & Mattson C, 2019. The Personification of Big Data. *Proceedings of the Design Society: International Conference on Engineering Design*, 1(1), 4019-4028.
Vallet F., Puchinger J., Millonig A., Lamé G., Nicolaï I., 2020. Tangible futures: Combining scenario thinking and personas—A pilot study on urban mobility. *Futures*, 117.

# 09 Customer journey map

**A Customer (or User) Journey Map (CJM)** is a description process of customers' or users' experiences for one or several services. It allows a better understanding of behaviors, motivations, thoughts, feelings and emotions of people, in order to enhance the design of products and services. It allows a usage viewpoint to be adopted.

Practically, it consists in representing a timeline on a day or any other duration and in describing the **user experience** of an existing person or a persona while uncovering the interactions and states experienced by him/her, represented by several lines to illustrate along the timeline.

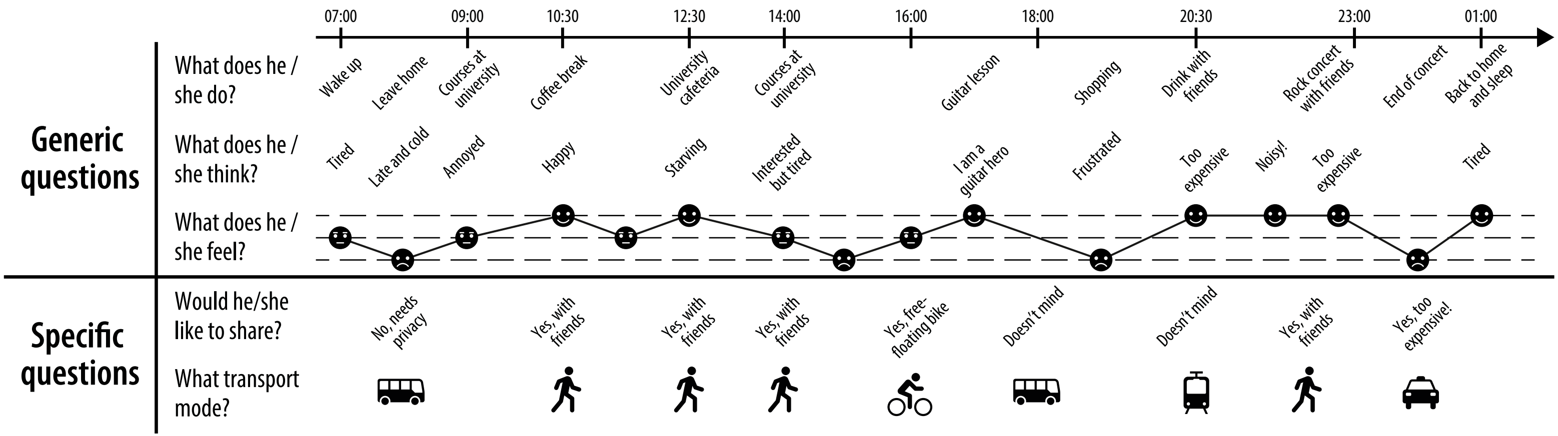
CJMs can be used (i) in **problem setting** to understand or represent existing situations, or (ii) in **problem solving** for creating an ideal desired future journey to live for a given persona.

## Example of Customer Journey Map for daily shared mobility

**User** Romane, student
Need to share moment with friends
Low financial resources
Night and day travels

**Mobility sharing** Yes, with friends, family or other people if relevant to decrease price

**Scenario** One week day with courses at the university + personal activities




## Need for a new innovation methodology

- **Linking experience to user categories** is something that CJMs do perfectly.
- **Inventorying value (gains) and non-value (pains) contributions** during an experience is done while elaborating a CJM. But this is not always easy to think of any contributive frustration, irritant, expectation, emotion that could feed this value/non-value contribution elicitation. A methodology should help here.

## Verbatims collected from Chief Innovation Officers

"I DO NOT really put my feet in the shoes of my current, non- and future customers to **simulate their future augmented activity**"

"I'd like to go **BEYOND the shallow user experience** with a consideration of his/**her full activity in situations**"

"Usually, due to industrial pressure, we spend **too LITTLE time in problem setting** and we have **poor learning coming from this problem exploration**"

"**TOO MANY trials and errors** to find the right innovation"

"We generally **FAIL to sufficiently explore** when innovating and we **lack traceability** of this exploration"


## Need for a new innovation methodology

- Aid to collect and leverage **user data**
- Aid to **explore problems and solutions**
- Aid to imagine **users in their everyday activity** and lives
- **Metrics and dashboards** to collectively understand and decide

# 11 Why might innovation methodologies be incomplete or flawed?

From our field survey,
we collected 21 needs for a complete **innovation methodology** and
evaluated the existing methodologies.

Radical Innovation Design® was
developed to meet these needs.

## Need for a new innovation methodology

| | Design Thinking | CK theory | TRIZ | Lean startup | Business Model Canvas | Blue Ocean Strategy | Radical Innovation Design® |
|---|---|---|---|---|---|---|---|
| Solution representation | 1 | 0 | 0 | 1 | 2 | 1 | 2 |
| Universality | 2 | 2 | 1 | 1 | 2 | 2 | 2 |
| Newness appraisal | 2 | 2 | 2 | 1 | 2 | 2 | 2 |
| Value measurement | 0 | 0 | 0 | 1 | 1 | 1 | 2 |
| User categorization and prioritization | 1 | 0 | 0 | 1 | 1 | 2 | 2 |
| Integration of Front End Innovation | 1 | 2 | 0 | 2 | 1 | 1 | 2 |
| Enhanced Problem Setting | 1 | 2 | 1 | 1 | 2 | 2 | 2 |
| Traceability and revisability | 0 | 1 | 2 | 0 | 2 | 1 | 2 |
| Qualified questions | 0 | 2 | 2 | 1 | 2 | 2 | 2 |
| Ideation reference frameworks and tools | 0 | 2 | 2 | 1 | 1 | 0 | 2 |
| Ethnographic approaches | 2 | 0 | 0 | 0 | 1 | 1 | 2 |
| User-centered and co-design processes | 2 | 1 | 0 | 2 | 1 | 1 | 2 |
| Knowledge about people and phenomena (UX++) | 1 | 2 | 1 | 0 | 0 | 1 | 2 |
| Process dynamics | # | 2 | 2 | 2 | 1 | 1 | 2 |
| Highest Value | # | 1 | 0 | 0 | 1 | 1 | 2 |
| Linking experience to user categories | 2 | 0 | 0 | 1 | 1 | 2 | 2 |
| Inventorying values and non-values | 1 | 2 | 1 | 0 | 2 | 2 | 2 |
| Aid to collect and leverage user data | 1 | 0 | 0 | 0 | 1 | 1 | 2 |
| Aid to explore problems and solutions | 0 | 1 | 1 | 0 | 0 | 0 | 2 |
| Aid to imagine users in their today activity and life | 1 | 0 | 0 | 0 | 0 | 0 | 2 |
| Metrics & dashboards to coll. understand & decide | 0 | 0 | 0 | 1 | 0 | 1 | 2 |

2 Fully implemented 1 Partially implemented 0 No implementation # Bad implementation

# Chapter 2

## Introducing important Radical Innovation Design® concepts

# 12 RID values and paradigms

All **innovation methodology** is based on philosophical values and paradigms. RID has three sources of inspiration: **Victor Papanek** and his criticisms of innovation frivolity, **Clayton Christensen** and his quest to help with customers' activities (jobs), and **Herbert Simon** with his definition of design as an improvement of situations people can live. RID embodies **humanist** values, with the goal of designing a more sustainable world.

In summary, RID seeks to create **usefulness** in the boundary of some **users' activity**, in changing **existing situations** into preferred ones.

RID paradigms are expressed by (a) the desirability and possibility to **qualify and quantify** what people aspire to and do not want anymore, (b) the systematic exploration of worthy paths of highest expected values, and (c) make an informed choice of innovative solution afterwards. RID takes further inspiration from the rational decision process of **Herbert Simon**.

**Usefulness**

**Improved situations**

**Customers' activites**

**Victor Papanek** has been nominated for the Alternative Nobel Prize. His message can be summarized by: "*Enough frivolity, let's develop a useful design!*"

**Herbert Simon** was awarded the Nobel Prize in Economics and received the Turing Award. He is, among others, considered to be one of the fathers of design sciences. His definition of design is: "*Everyone designs who devises courses of action aimed at changing existing situations into preferred ones.*"

**Clayton Christensen** has been named the Number 1 Management Thinker in the World by Thinkers50. His message can be summarized by: "*The secret to innovation success is to allow your customers to improve their job performance (jobs-to-be-done concept)*"

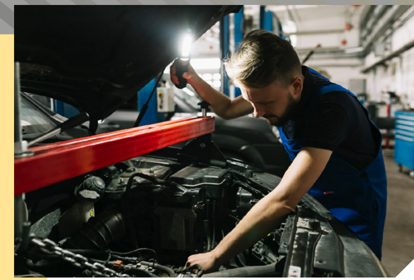
***SOURCE***

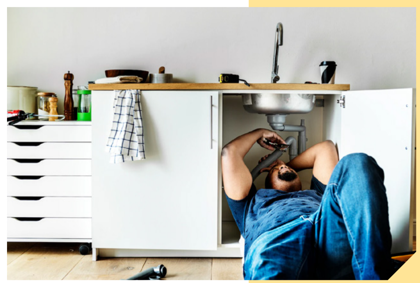

Papanek V., 1971. Design for the real word – Human ecology and social change, Academy Chicago Publishers, New York, ISBN: 978-0897331531..
Christensen C., 2003. The Innovator's Solution: Creating and Sustaining Successful Growth, Harvard Business School Press, ISBN: 978-1578518524..
Christensen C., 2011. The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business, Harper Business, ISBN: 978-0062060242..
Simon H.A., 1996. The Sciences of the Artificial. MIT Press, third edition, ISBN-13: 978-0262691918.

# 13 Activity at the core

**Activity** is at the core of RID's approach to innovation.

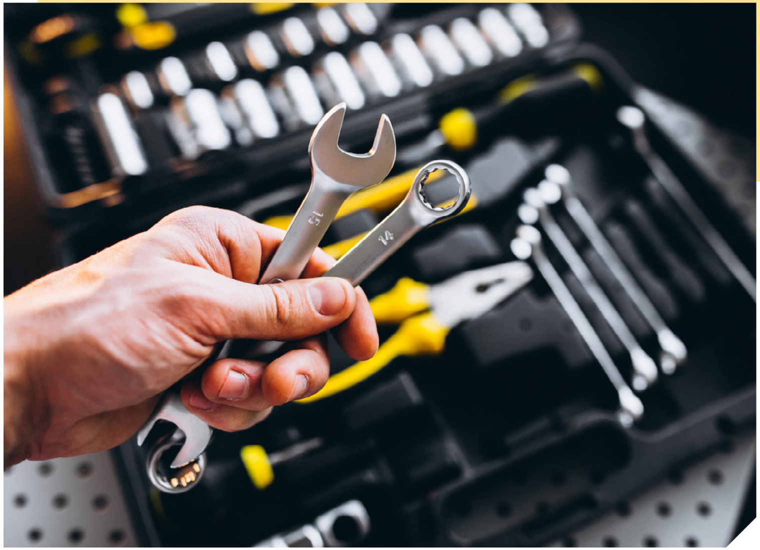
As designers, we propose to apprehend the world around us through **people of different kinds** (**user profiles**[1]) who practice an **activity**, itself made up of different **moments/episodes/scenes** (**usage situations**) during which people experience different **pains/dissatisfactions** or have **expectations** (**problems**) that are more or less taken into account by existing **solutions**.





1. Note that user profiles can be generalized to systems, components or other non-living stakeholders

**Users** all have their own **way of practicing** an **activity**, of being **satisfied** or **frustrated** with it, of using **particular solutions**, adapted or not, to do so.



A universal solution never fits all. A particular solution suits a **category of people** at a **given moment**. Knowing how to identify **situations** where there are no **effective solutions** is fundamental to **useful** and **profitable** innovation.

In RID, it is possible to model the state of (a) **current activity**, (b) **ideal activity**, (c) **augmented activity** thanks to a useful innovative solution, by modeling the mosaic of usage situations experienced by users of different profiles and experiencing problems or degrees of satisfaction according to the existing solutions used.

# 14 The way RID uses activity theory

The Radical Innovation design® (RID) methodology innovates in a complex system from the users' point of view. Indeed, with RID:

- The **activity** is the object of study
- The usages are deeply analyzed to **disrupt the user experience** (UX)

RID considers innovative design as the improvement of the activity support system based on **Engeström's Activity System Diagram** theory (1999).

Further, RID considers innovative design as the **improvement of the activity-support-system** to augment the performances of a **future activity**.

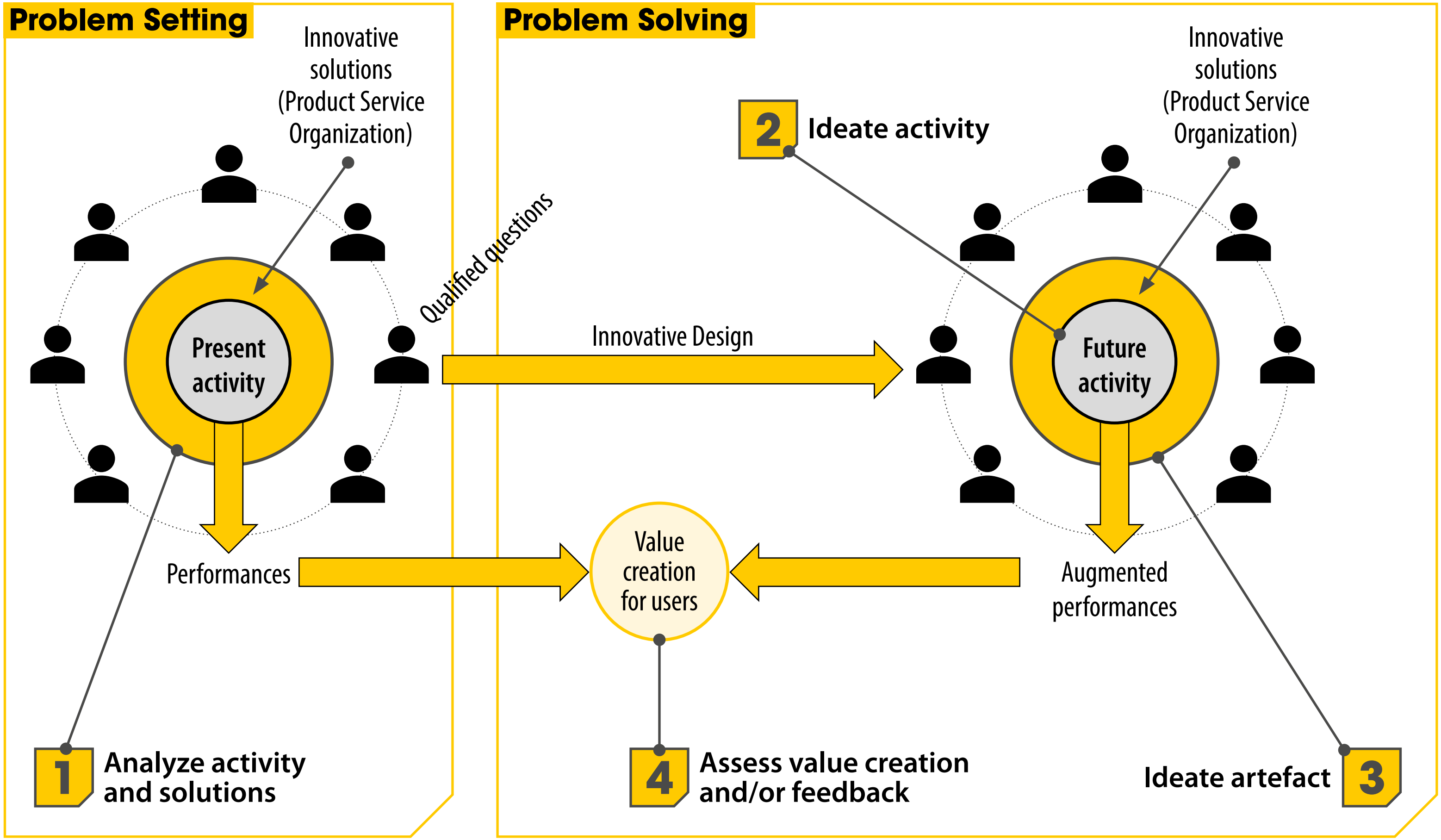
When starting a RID study, the initial idea provided to the innovation team is immediately re-expressed to fit into the study and improvement of an activity (see **reframing**).

**1** The present activity is surveyed as much as we can (**knowledge design** sub-process) so as to formulate qualified questions (called **value buckets** in RID).

**2** These questions will serve to imagine a future activity (see **dreamt usage scenario**)…

**3** … and then a new innovative solution (the activity artefact).

**4** Finally, the augmented performances of the activity are confirmed thanks to the **RID comparator**.




***SOURCE***
Engeström Y., Miettinen R., Punamäki R.-L., 1999. Perspectives on activity theory, Cambridge, UK: Cambridge University Press, ISBN: 978-0521431279..

# 15 What can be designed or innovated?

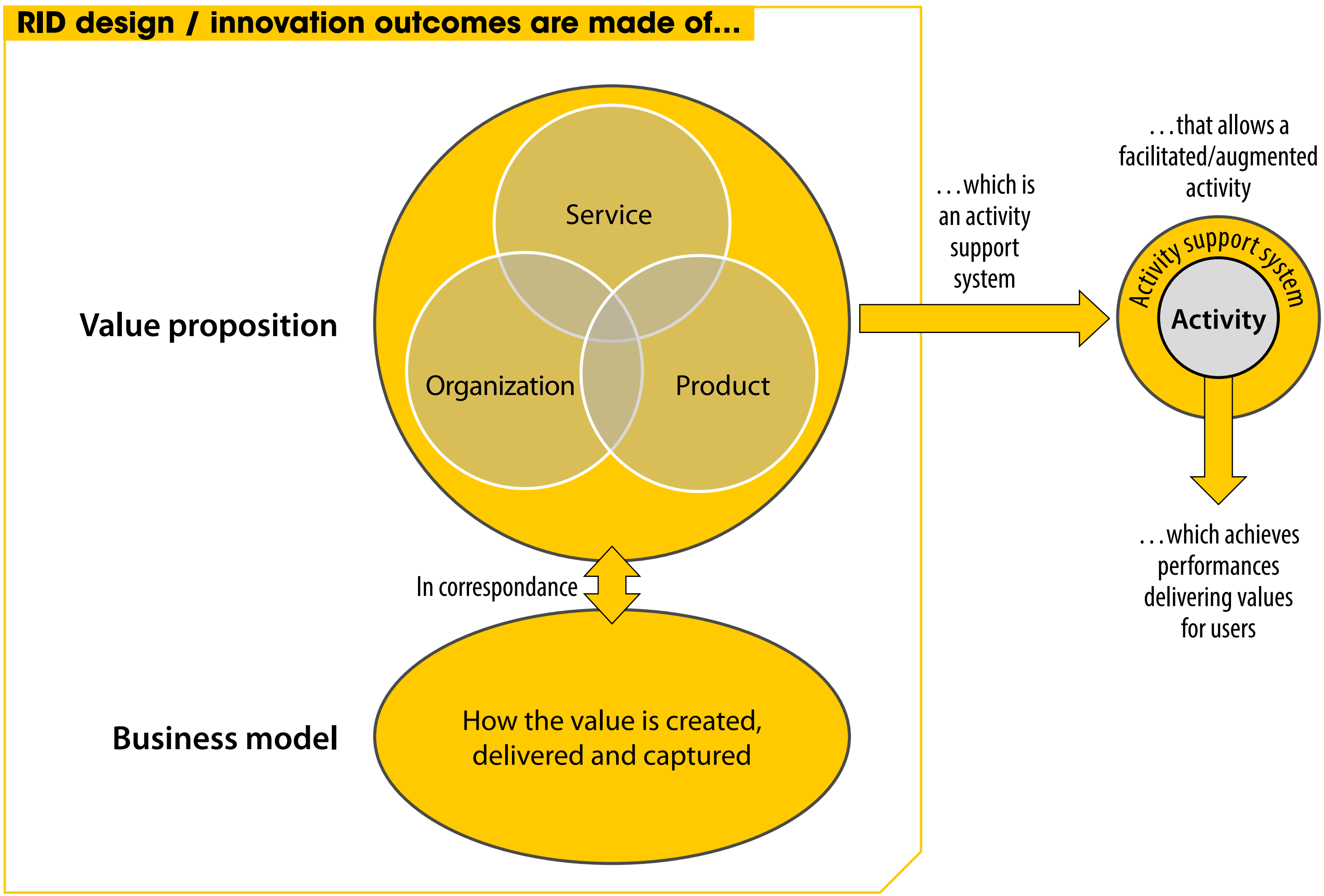
The **innovation outcome of a RID study** is made of:

- A **value proposition** made of a compound of Products-Services-Organizations (PSO). This PSO value proposition is a mediating artefact (see **Activity System Theory**) that changes and augments the performances of the activity.
- A **Business Model** (BM).

Innovations and disruptions thus lie in the PSO part as well as in the BM part. The RID process advocates for a parallel design of both parts (see **RID process**).

**What can be designed/innovated?**

- Product
- Service
- Product-Service System (PSS)
- Business model
- Activity
- Organization
- System
- User Experience (UX)
- Miscelleneaous (policy, strategy, regulation, process, software, study, curriculum, healthcare, vision, text, artwork…)
- … Everything!

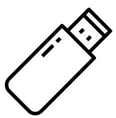

RID design / innovation outcomes are made of...
Value proposition
Service
Organization
Product
In correspondance
Business model
How the value is created, delivered and captured
...which is an activity support system
...that allows a facilitated/augmented activity
Activity support system
Activity
...which achieves performances delivering values for users

# 16 Innovation intensity and radicality

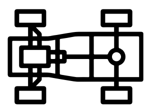
## Definition by Henderson and Clark

Several rationales exist to characterize innovation or idea types and their **intensity**. The **radicality of innovation** can be defined based on this rationale.

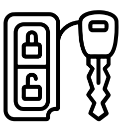
| | | Relations between components | |
|---|---|---|---|
| | | Do not change | Change |
| Reference technologies | Do not change | Incremental Innovation 1 | Architectural Innovation 2 |
| | Change | Modular Innovation 3 | Radical Innovation 4 |



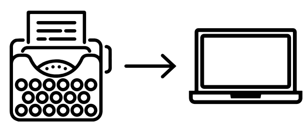
USB drive with an increased capacity 1



From rear-wheel to front-wheel drive 2



Remote keyless car 3



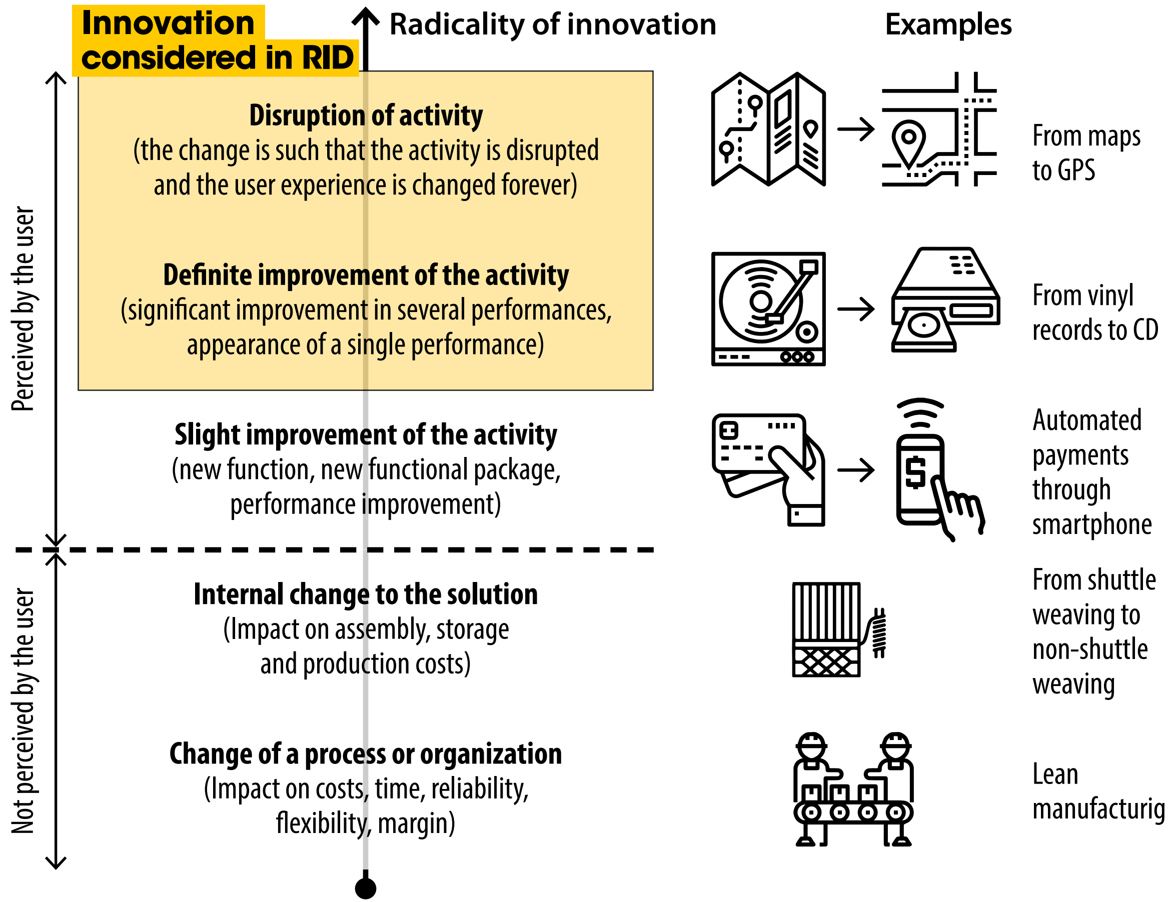
4

From typewriter to computer

This model by Henderson and Clark (1990) is based on architectural modifications along with the possibility of adopting a new core technology. It results in four types of innovation with different impacts on industrial organization, investments and risk management.

# Definition by RID

The **usage-oriented** definition of **radicality** by RID introduces a scale of usage perception and **usefulness** from the viewpoint of users, from an **innovation** on industrial process or organization which is **not perceivable by the user** until a sustainable modification of the **user experience** (UX). For RID, a **radical (user-centered)** innovation necessarily impacts on **user activity** or experience.




***SOURCE***
Henderson R. & Clark K.B., 1990. Architectural innovation: the reconfiguration of existing product technologies and the failure of established firms, *Administrative Sciences Quarterly*, 35: 9–30.

# 17 Disruption

In RID, a **disruption** is a **radical user-centered innovation**, i.e. an innovation that changes users' activity or experience. To that end, one needs a superior end-user understanding, by following a **need seeker strategy**. Radical Innovation Design® requires the objectification and prioritization of **value buckets** in order to start such an **innovative process**.

The Dyson innovative process is similar to the RID process.

### The 4 disruptions of the Dyson Airblade hand dryer

Dyson Airblade presents 4 **disruptions** in terms of **radical user-centered innovations**:

1. **Much faster**: more than twice as fast, drying in less than 15 seconds. To prove it, Dyson initiated the first protocol for a hygienic commercial hand dryer (NSF Protocol P335);
2. **Very energy efficient**: 6 times less electricity used;
3. **Very hygienic**: touch-free, air filtration, no drain tank, 40% less bacteria, no water projection on shoes;
4. **Very economic**: no maintenance, 4 times less expensive per year.

## Dyson's need seeker innovation process

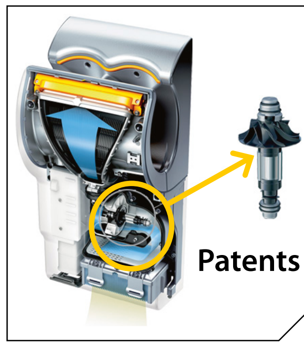
**Non-formulated need**
(equivalent to RID **value buckets**)

- Faster
- Energy saving
- Hygienic
- No maintenance

**New usage**
New principle of drying using a mechanical effect along with forced convection

**New Technology**

- New principle of pulsed airblade at 640 km/h
- New technology and patents of ultra speed brushless electrical engine




**New experience**

- Comfort
- ROIs often in less than 1 year

# 18 RID value proposition

**Augmenting people's activities or system/component's interactions**

**...through innovation project management (external) or change management (internal)**

**...by the design of adequate products, services, organizations and business models that are useful for users or system, and profitable for companies.**

## The two RID objectives to maximize

The two objectives of RID are:

- maximization of **usefulness** for users. For that, RID invented the "**quantities of pain**" metrics;
- maximization of the **profitability** and strategic opportunities for the company. For that, RID offers the **RID comparator** decision aid and the **ambition perimeter** sub-process.

These two objectives are constantly evaluated in order to find the most suitable compromise:

**1.** problems on which to innovate (ambition perimeter) AND

**2.** innovative Product-System-Organization + Business Model solution .

## Who are the activity practitioners and beneficiaries?

The promise of RID is to augment activity for both the activity practitioners and beneficiaries. But these stakeholders are not necessarily human beings. Indeed, they can be systems, components, a territory or the planet (with the stake of its preservation). Consequently, RID may be used for an innovative design in a Systems Engineering process, the user categories becoming system categories.

## Innovation management and change management in a same activity-based approach

RID is a complete methodology. As it is based on the universal activity approach, RID may be used in two use cases:

- For **Innovation Project Management**;
- For **Change Management**. For instance, if you want to innovate on your internal processes for developing an activity such as "being more customer-oriented", "promoting gender equality", or "offering greener products".

## Is there always an existing activity to survey?

In a high majority of cases (let's say 95% of time), an activity already exists. For instance, before Apple launched the iPad, people were not browsing their tablet with three fingers to read their digital news (paper), but they just were reading newspapers. But, the study of their traditional practices is of great interest for the renewal of the activity.
When considering an activity, one also must consider people who do not practice but would dream to (they are called the **non-users**) so as to also innovate for them to re-practice again (imagine a handicapped person dreaming of skiing).
In the rare cases where no such activity exists, **methods of prospective (or future studies)** must be employed to mine the memory of futures that have already been imagined.

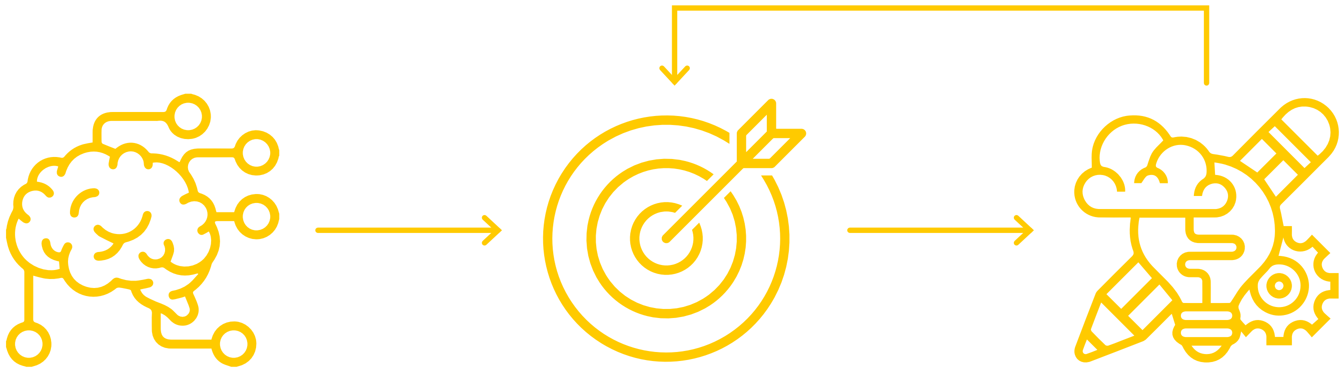
# 19 RID – The basic process

## Analyzing today's activity to imagine tomorrow's through a controlled process

The **RID process** works in three stages:

1. Observe today's activity and learn about it by **building a cognitive model** of current practice.
2. Explore this cognitive model and **select the innovation targets**.
3. From the the innovation target; **Ideate, design and check that your innovative solution(s) effectively augment(s) the user's activity**.

The process of improving an activity through the **RID design process** has already been illustrated in four papers. In (Bekhradi et al. 2017), do-it-yourself activities are investigated to innovate on an innovative universal accent light solution. With the aim of analyzing the often low environmental performances of a building, Lamé et al. (2017) used RID methodology to analyze the contribution of existing design and organizational solutions and the imperfections of the design activity for a building, such as fragmentation of the participation of the actors in the construction, failure to implement LCA, eco-design approaches and environmental standards, and/or the lack of consultation among the actors in the value chain. In (Lamé et al. 2018), the authors analyzed the activity system of a dental radiologist to derive neglected areas based on "quantities of pains and expectations" from which they ideate to further define innovative socio-technical layout solutions. Salehy et al (2021) used RID to model the design and maintenance activity of a supermarket refrigeration system to highlight the lack of early coordination of actors and a shared integrated digital mockup.



**OBSERVE & LEARN**

**Investigate**, **Understand** and **Represent** current practice in a cognitive model

**EXPLORE & DECIDE**

**Interrogate** the cognitive model to detect zones of orphan pains
**Shrink** market space
**Get** qualified questions to start ideation

**IDEATE, DESIGN & ASSESS**

**Ideate** a dreamt usage scenario
**Design** a (PSO and BM) solution
**Assess** the outcoming activity and check that your solution is useful and profitable enough
Possibly, **Feedback**


***SOURCE***

Bekhradi A., Yannou B., Cluzel F., Vallette T., 2017. Categorizing users' pains, usage situations and existing solutions in front end of innovation: The case of smart lighting project. *21st International Conference on Engineering Design (ICED)*, Vancouver, Canada

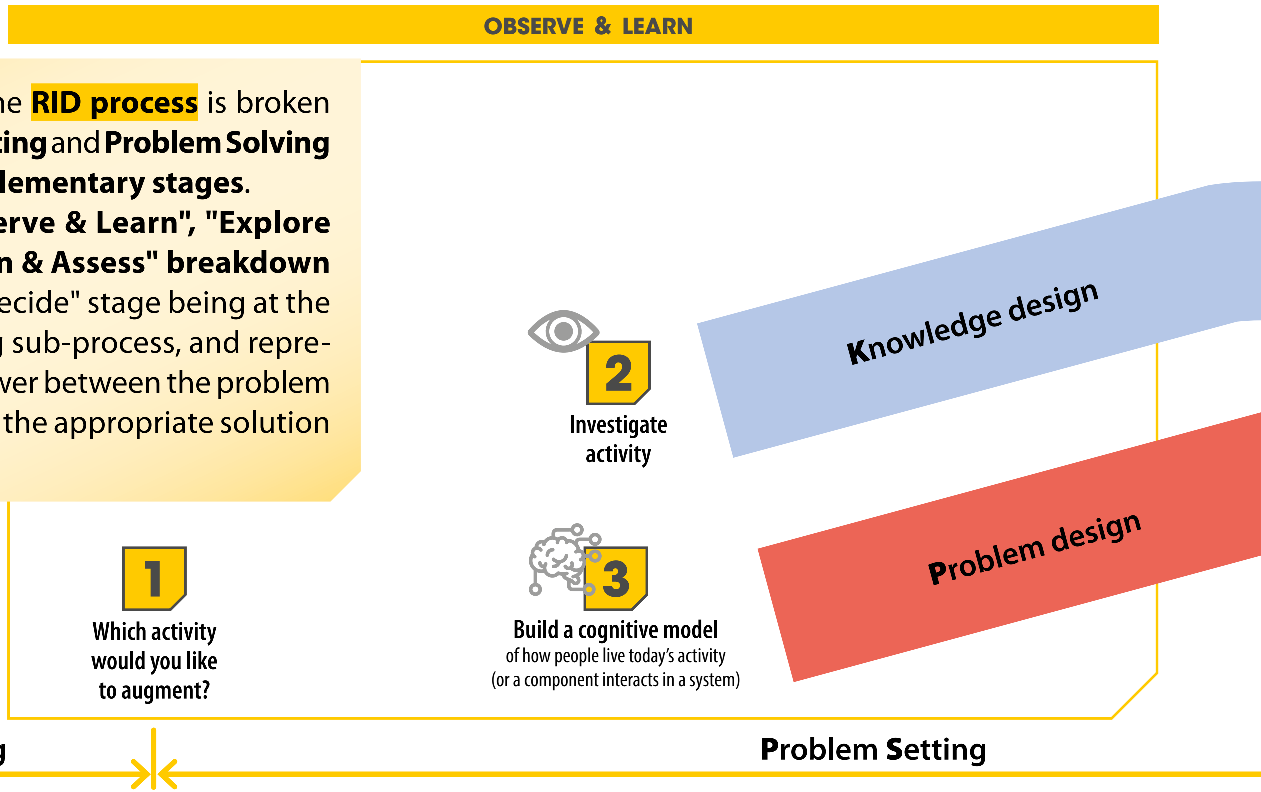
Lamé G., Leroy Y., Yannou B., 2017. Ecodesign tools in the construction sector: Analyzing usage inadequacies with designers' needs. *Journal of Cleaner Production*, 148:60–72.

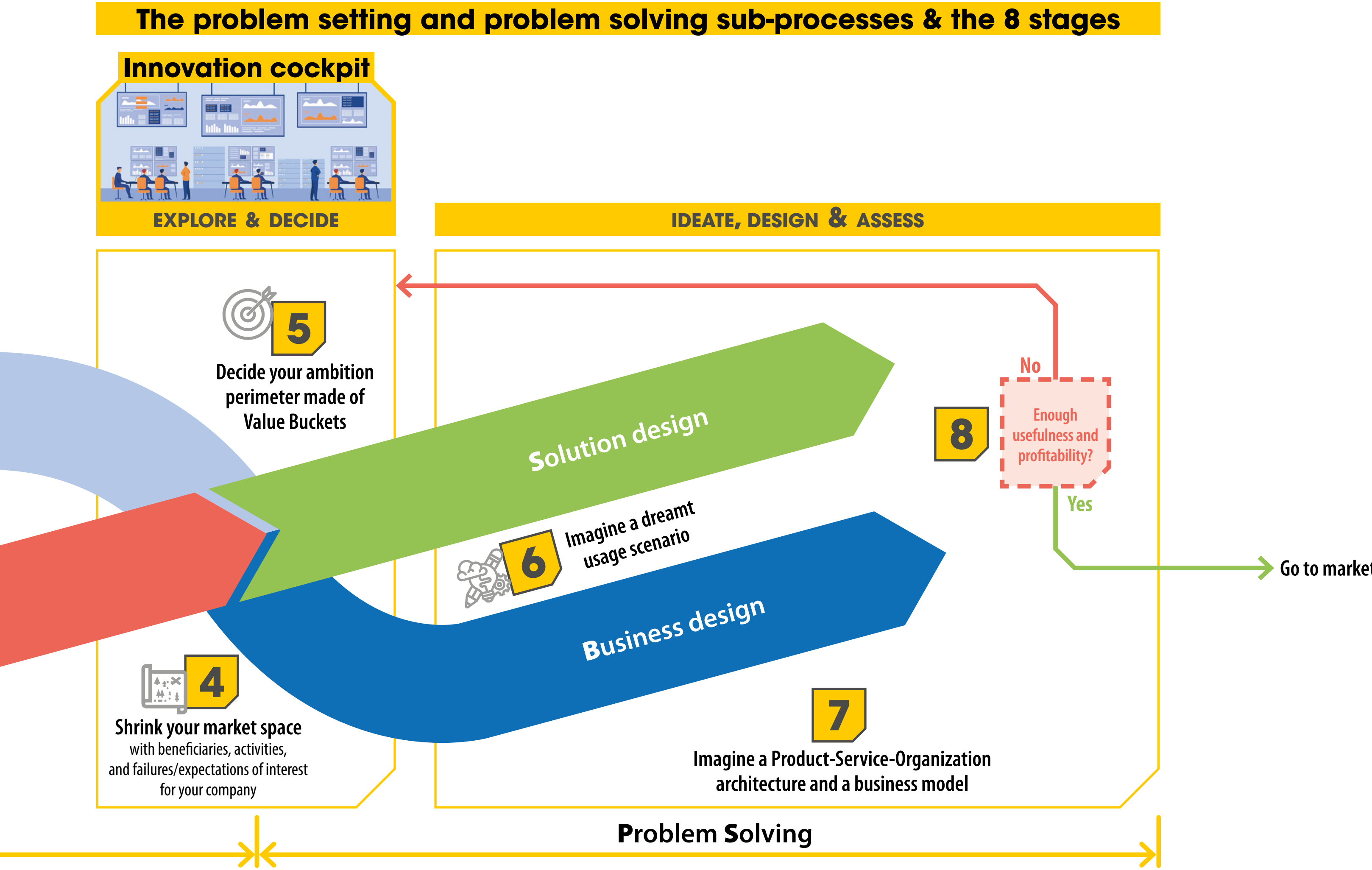
Lamé G., Yannou B., Cluzel F, 2018. Usage-driven problem design for radical innovation in healthcare. *BMJ Innovations*, 4(1):15–23.

Salehy Y., Yannou B., Leroy Y., Cluzel F., Fournaison L., Hoang H.-M., Lecomte R., Delahaye A., 2021. Diagnosis of development opportunities for refrigeration socio-technical system using the radical innovation design methodology. *Proceedings of the Design Society*, 1:1263–1272.

# 20 RID – The intermediate process

At an intermediate level, the **RID process** is broken down into two **Problem Setting** and **Problem Solving** sub-processes, made of **8 elementary stages**. Another view is the **"Observe & Learn", "Explore & Decide", "Ideate, Design & Assess" breakdown** — the central "Explore & Decide" stage being at the end of the Problem Setting sub-process, and representing a kind of control tower between the problem that has been selected and the appropriate solution to be designed.





The problem setting and problem solving sub-processes & the 8 stages
Innovation cockpit
EXPLORE & DECIDE
IDEATE, DESIGN & ASSESS
5
Decide your ambition perimeter made of Value Buckets
Solution design
No
8
Enough usefulness and profitability?
Yes
Go to market
6
Imagine a dreamt usage scenario
Business design
4
Shrink your market space
with beneficiaries, activities, and failures/expectations of interest for your company
7
Imagine a Product-Service-Organization architecture and a business model
Problem Solving

# 21 RID – The 8 stages

The **RID process** is at the heart of the **Radical Innovation Design® methodology**. In contrast to the traditional linear **Design Thinking process**, the **RID process** is a much more structured X-shaped process resulting in fewer design backward loops. This is due to its **set-based thinking exploration-exploitation** principle. The **RID process** is split into two parts: **problem setting** and **problem solving**, the former consisting of **knowledge design** and **problem design**, and the latter of **solution design** and **business design**.

**8 major stages are identified:**

**1** Stage #1 consists of starting with an **"initial idea"** and transforming it into an **activity** whose performance we would like to improve, or into a series of activities to be studied each through a RID process. In this second case, which is the search for innovative applications for a technology, it is advisable to list and prioritize these potentially interesting activities to be revisited according to (i) a potential for creating **usefulness**, (ii) a potential for **profitability**, and (iii) strategic considerations about the company and the concerned markets concerned.

These three criteria are the same as those used in the application of a single RID process, and an adapted method exists, that is not presented in this version of the eBook.

**2** Stage #2 "Observe" is assimilated to **Knowledge design** where the today and tomorrow activity is investigated.

**3** Stage #3 "Learn" is associated to **Problem Design**, i.e. the coding and the learning of the activity cognitive model.

**4** **5** Stage #4 and Stage #5 are associated to the **RID comparator** and the **RID compass** tools, which have their own "Explore" and "Decide" parts.

**6** Stage #6 "Imagine a **dreamt usage scenario**" concerns both the **Business design** and the **Solution design** parts.

**7** Stage #7 is the **conceptual design** of the Product Service Organisation part as well as the Business model part.

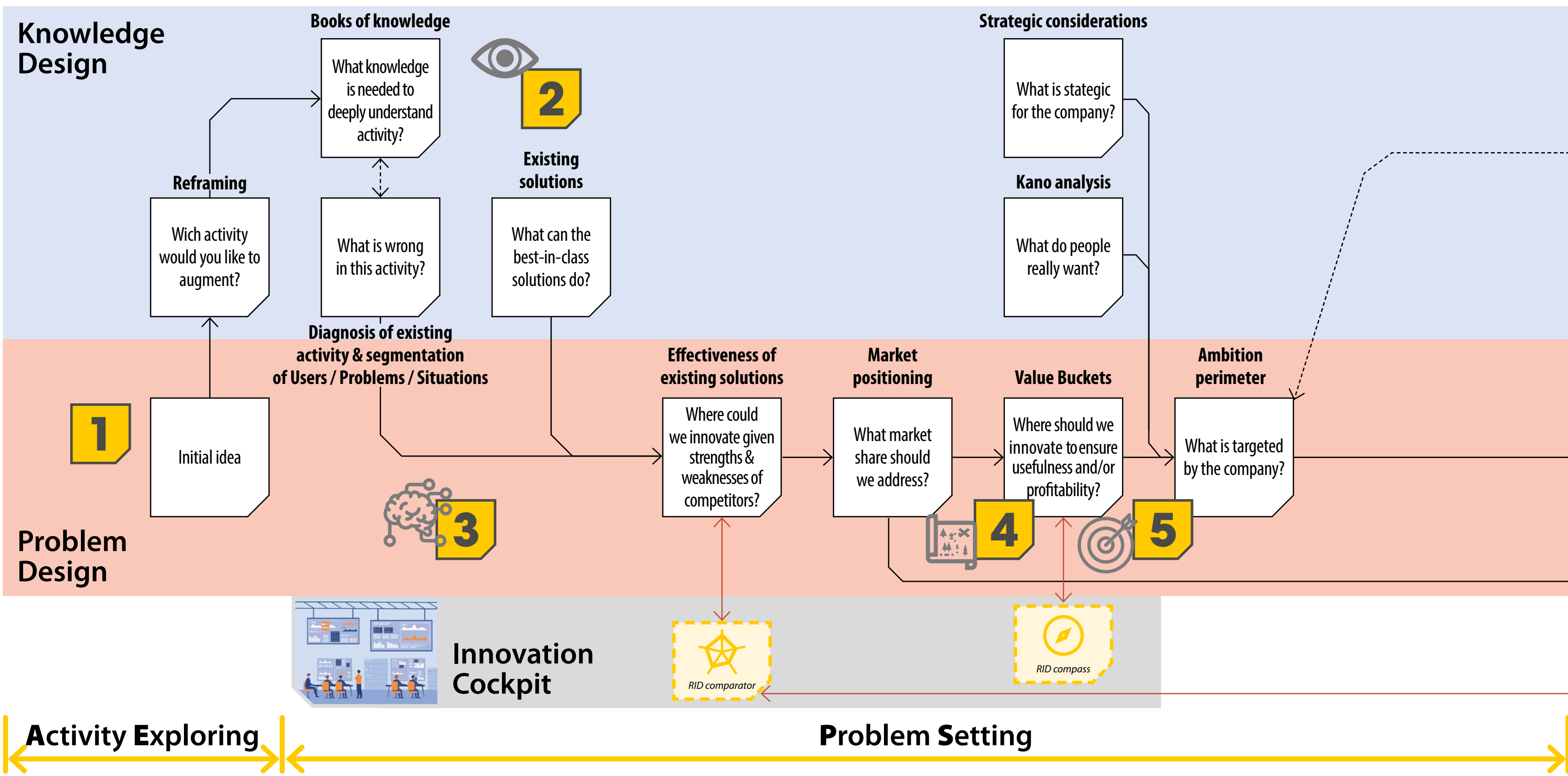
**8** Stage #8 is the **final assessment** of both the usefulness and the profitability of the whole (Product Service Organisation + Business Model) solution. This leads either to industrialize the solution, or to go back on the "Explore and Decide" steps to modify the outline of the problem to be addressed.

***SOURCE***

Yannou B., Cluzel F., Farel R., 2016. Capturing the relevant problems leading to pain and usage driven innovations: the DSM Value Bucket algorithm. *Concurrent Engineering - Research And Applications (CERA)*, 1-16.

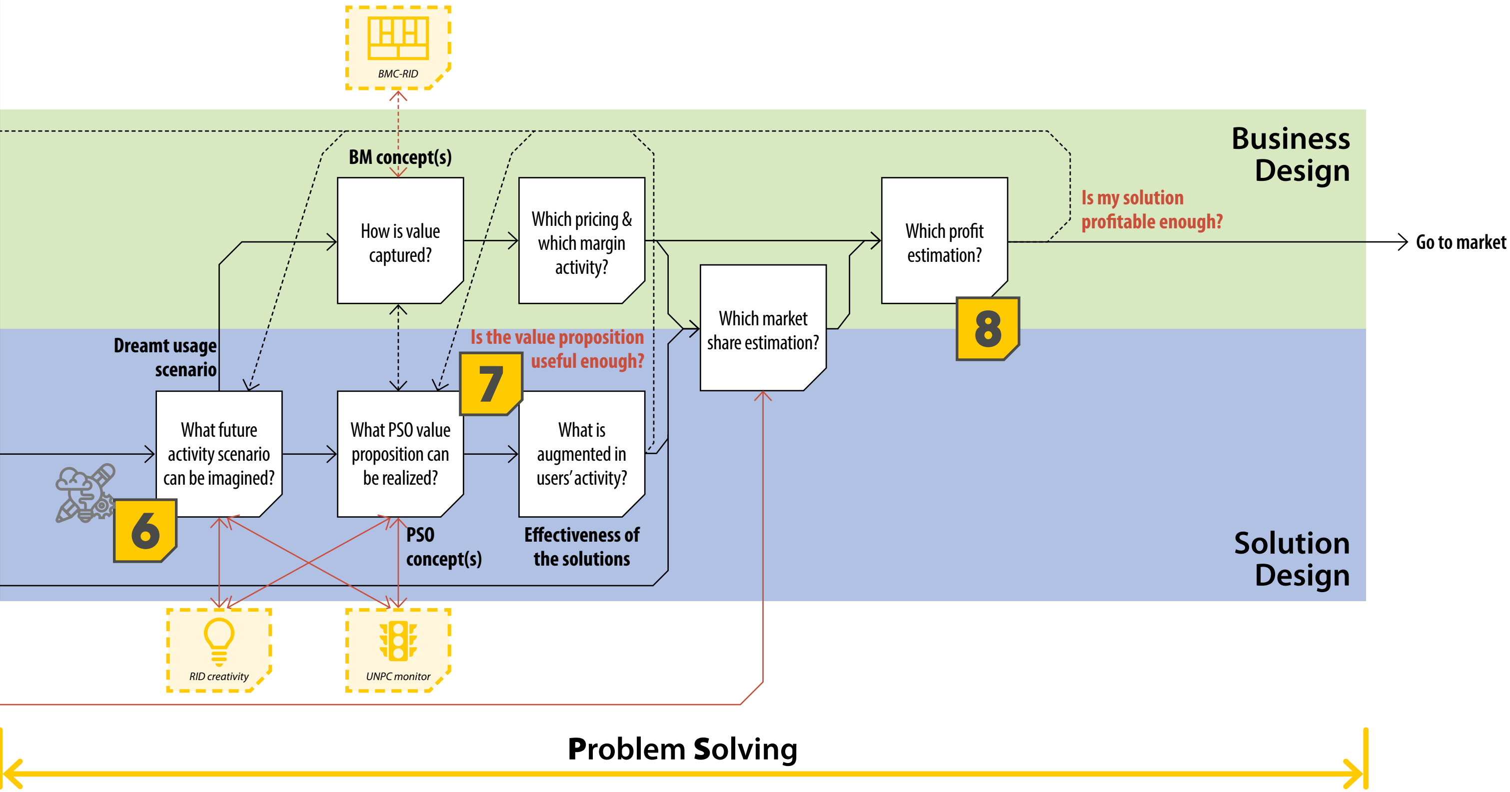
Bekhradi A., 2018. Planning technology maturation by exploration of useful problems in markets: The case of innovative startups. *PhD thesis*. Université Paris-Saclay.

# 22 RID – The detailed workflow



Innovation becomes a structured, controlled and optimized production process.

Take time to study this **detailed flow diagram** to fully understand the major questions a RID study raises, how they chain, the precedence, concurrence and feedback conditions, as well as the 5 main methods and tools.



# 23 A complete innovation methodology

**Why Radical Innovation Design® is a complete innovation methodology?** Come back to Innovation definition:

**Innovation** is both a process and an outcome, in which **something new** is **created** that brings **value** to particular **people**.

**Creating – RID** is a complete **innovation methodology** based on an original **(UDIP) model of designing**, a **design process** and several tools and methods (**UNPC monitor tool, RID creativity tool, RID Comparator, RID Compass, BMC-RID**).

**Something – RID** considers that innovation outcome of a RID study is made of (i) a **value proposition** made of a compound of Products-Services-Organizations (PSO), this PSO value proposition being a mediating artefact with users that augments the performances of the **activity**, and (ii) A **Business Model** (BM).

**New – RID** uses the **UNPC innovativeness indicators** to appreciate this newness as a whole. The **newness** is assessed from the perspective of the users.

**Value** – In **RID**, value is primarily measured, within an **activity field**, by the **usefulness** that may be created by the improvement of this activity or by its outcome (compared to current practice as well as to best-in-class practices).

**People** – **RID** gives utmost priority to creating value for users in **one or more of their activities**, addressing private or professional concerns. Several **user profiles** may be considered as long as they can be considered as beneficiaries of the activity. Secondary **beneficiaries** such as value chain actors can sometimes be deliberately sidelined or downplayed to focus solely on producing value for end customers, which can consequently disrupt the supply chain.

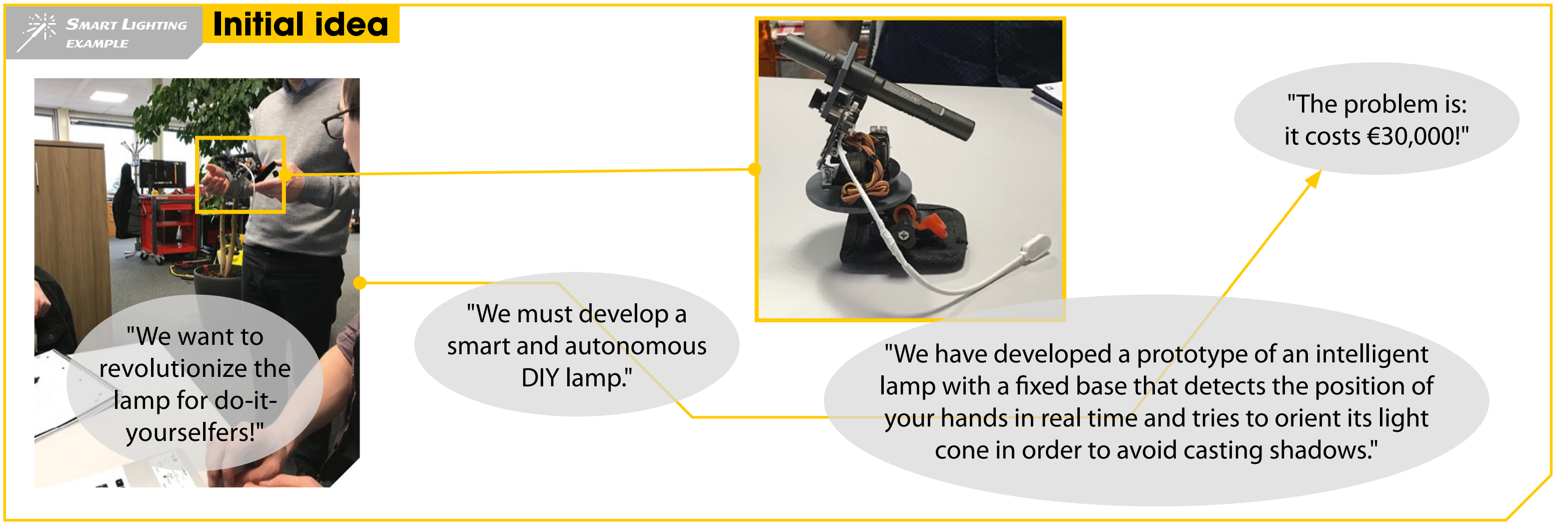
# Chapter 3

## A brief journey in a Radical Innovation Design® process

**This chapter discusses the typical steps and concepts involved in a RID study example that is detailed in the following publication:**
Bekhradi A., Yannou B., Cluzel F., and Vallette T., 2017. Categorizing users' pains, usage situations and existing solutions in front-end of innovation: The case of smart lighting project, *21st International Conference on Engineering Design (ICED)*, Vancouver, Canada, August 21-25.

# 24 Evaluate initial ideas carefully!

**The RID process presented in this chapter is a real example.** An innovation manager of major international household hardware company asked us to rethink a lamp for do-it-yourselfers. Which can appear as a vain injunction (see **nature of an idea**) as such an expression is not based on something tangible…



# 25 Define an activity

Define the **activity** as a system boundary and don't be influenced by current product segmentation when considering user categories. The **ideal goal** corresponds to when the **activity** outcome performance is set at 100%.

SMART LIGHTING EXAMPLE

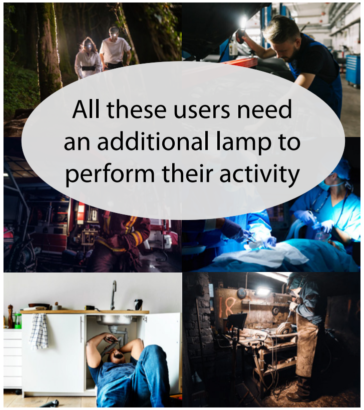
## Activity, ideal goal and (non-)users

Bring additional light to perform a task

**Define activity boundary**

Optimize the comfort of vision in the realization of a task without restraining movements and attention

**Define ideal goal of activity**



All these users need an additional lamp to perform their activity

**Define user categories (user profiles)**

**Ground observations and interviews:** dentists, electricians, mechanics, plumbers, plasterers, truck drivers, sewer inspectors, firemen, surgeons, security agents, DIY activities, sport activities

Generate **observation sheets** and **books of knowledge**

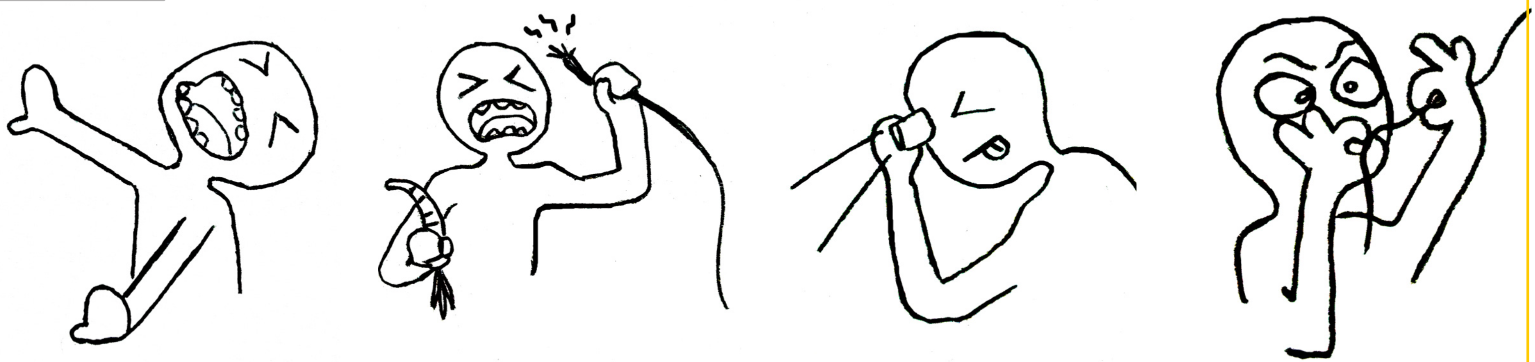
**Investigate all the sub-activities or activity variants**

# 26 Categorize usage situations

A **usage situation** is an episode, a particular scene, a series of actions, one of the processes or a task which defines a part of the activity.

SMART LIGHTING EXAMPLE

**Recurring usage situations**



Moving in dark environments | Manipulating an object in a dark environment | Precise localised inspection | Precise localised manipulation

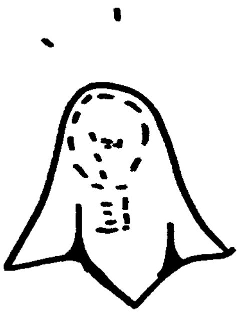
All these **usage situations** can be experienced indifferently by plumbers, electricians, mechanics or surgeons. It is therefore interesting to develop generic solutions that provide answers to these **archetypal situations**, while adapting to the specificities of the user categories.

# 27 Categorize problems

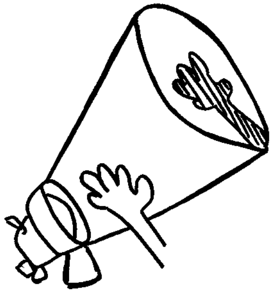
Pains and gains are two sides of the same coin. They can be defects, lacks, issues, dissatisfactions, or expectations, desires. In RID, they are all called **problems** and expressed as counter-performances to augment.

SMART LIGHTING EXAMPLE

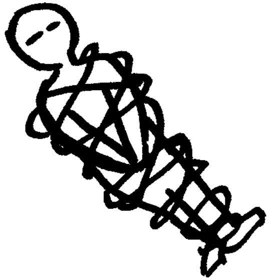
**Experienced problems**



Inadequate lighting



Shadows cast by body



Restriction of movement

Cognitive overload

All these **problems** can be experienced indifferently by plumbers, electricians, mechanics or surgeons. It is therefore interesting to develop generic solutions that provide answers to these **archetypal problems**, while adapting to the specificities of the user categories.

28

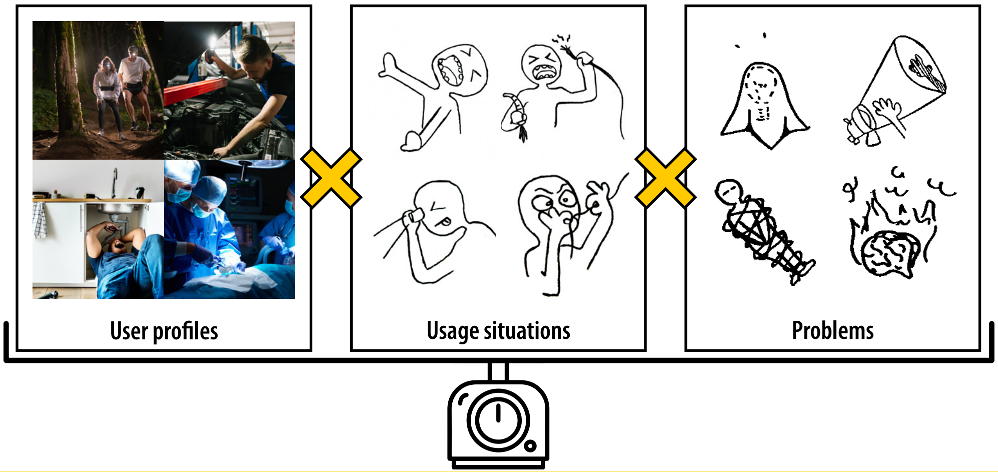
# Quantites of pain

## A new metrics to focus on useful innovations

In RID, we invented a new unified metrics to assess the "**quantites of pain**" and expectations within the boundaries of an activity. This metrics is extensive; summations and comparisons can be done.

SMART LIGHTING EXAMPLE

**Quantites of pain**




*SOURCE*

Yannou, B., Lecomte, R., & Cluzel, F. (2024). RID journal paper – RID comparator and Cleaning solar panel study (Version V1). Zenodo.

# 29 Categorize existing solutions

**An innovation claim is necessarily made with regards to existing solutions**! In RID, **existing solutions** range in their utility in alleviating identified **problems**, and therefore in their relevance and effectiveness during usage situations, in their accessibility and affordability to **user profiles**. **Existing solutions** are categorized or clustered for their ability to better highlight differences against **usage situations**, **problems** and **user**.

SMART LIGHTING EXAMPLE

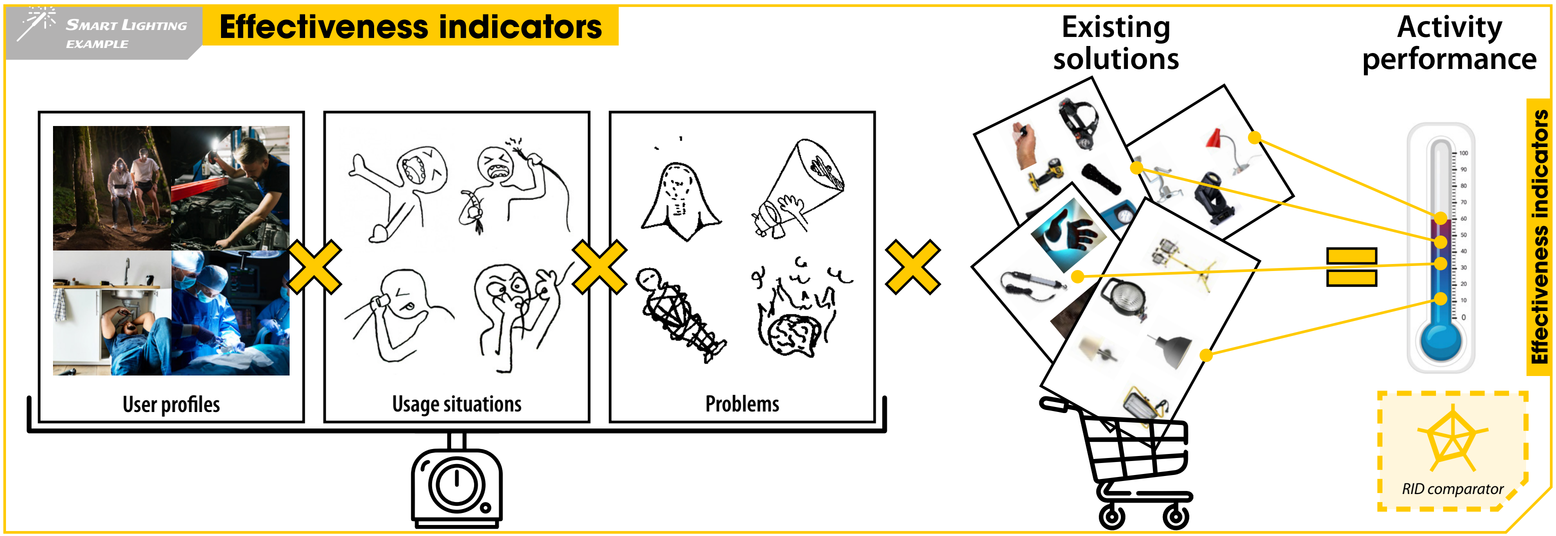
## Existing solutions

| | Diffuse | Directional |
|---|---|---|
| Fixed |  |  |
| Movable and controllable |  |  |

# 30 Effectiveness indicators

## A first decision-making set of indicators

We invented **effectiveness indicators** to assess the ability of solutions to remove quantities of pain. They allow us to figure out where there is still usefulness to create and to **focus on a given market**. **Effectiveness indicators** are expressed between 0% to 100% on an **activity performance scale**, they are computed by original algorithms of the **RID Comparator method**.



# 31 Usefulness

**Usefulness** is defined in RID by the ability to **remove quantities of pains**. **Usefulness indicators** are computed from effectiveness indicators. It accounts for the **part of relief that a solution can bring to the practice of an activity**.

RID's hypothesis in favoring useful solutions is that their market share will be at least proportional to their **usefulness** (according to one of the three definitions) and that word of mouth will eventually disclame its superior performance in activity.

We can imagine **3 types of usefulness measures** – measured as a %, for existing or innovative solutions (see also **scale of activity performances**):

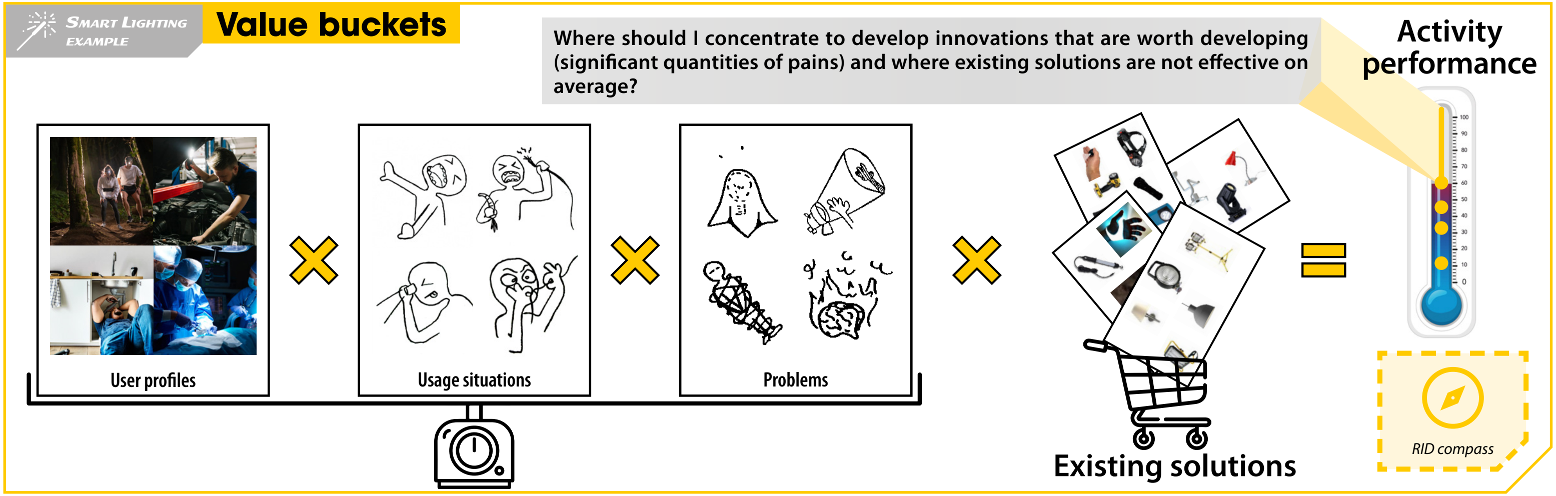
1. **Intrinsic usefulness**, defined as the potential for a solution to relief the activity per se.
2. **Relative usefulness** of one solution over another accounts only for (users, situations, problems) zones where the first solution surpasses the second one. It can be 0% in case of total dominance of the second. **Solutions which are totally dominated by all the other solutions must be removed from the market!**
3. **Specific usefulness** of a solution is calculated against the best-in-class solutions for all (users, situations, problems) areas. **This measure indicates when it is not fixed to 0% that the solution displays blue oceans** (see BOS methodology) and is radically disruptive (as defined by RID).

# 32 Value Buckets

## A second decision-making set of indicators

We invented **value buckets** to precisely express high value and differentiating innovation leads in order to start ideation with qualified questions.

**Value Buckets** are areas (*users, situations, problems*) with an intensity that is both proportional to the amount of quantities of pain and inversely proportional to the average effectiveness of existing solutions. **They indicate where you can create relative and specific usefulnesses.** They are computed by original algorithms of the **RID compass**.



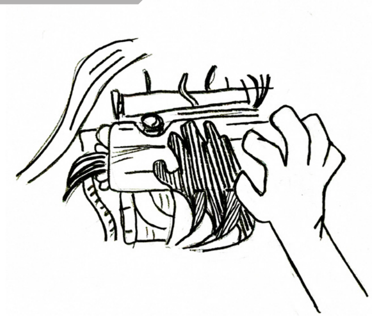
# 33 Ambition perimeter

The subset of selected value buckets that the company finds strategically adapted to its growth is called an **ambition perimeter**.

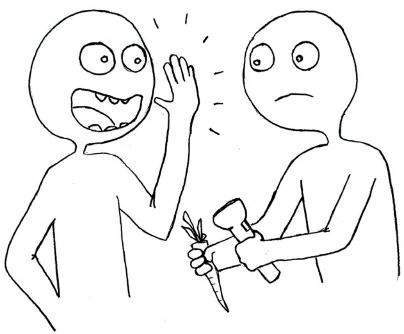
An **ambition perimeter** is much more valuable and justified than a traditional marketing or innovation brief, since the systematic RID problem setting stage and its metrics and algorithms guarantee its legitimacy.

SMART LIGHTING EXAMPLE

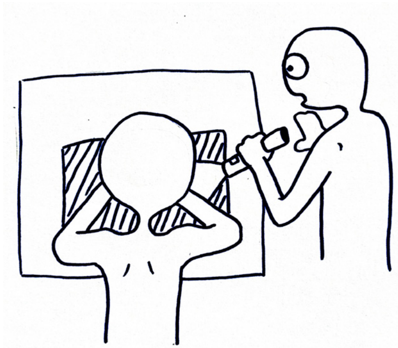
**Ambition perimeter**



**Being able to manipulate an object precisely without casting shadows**



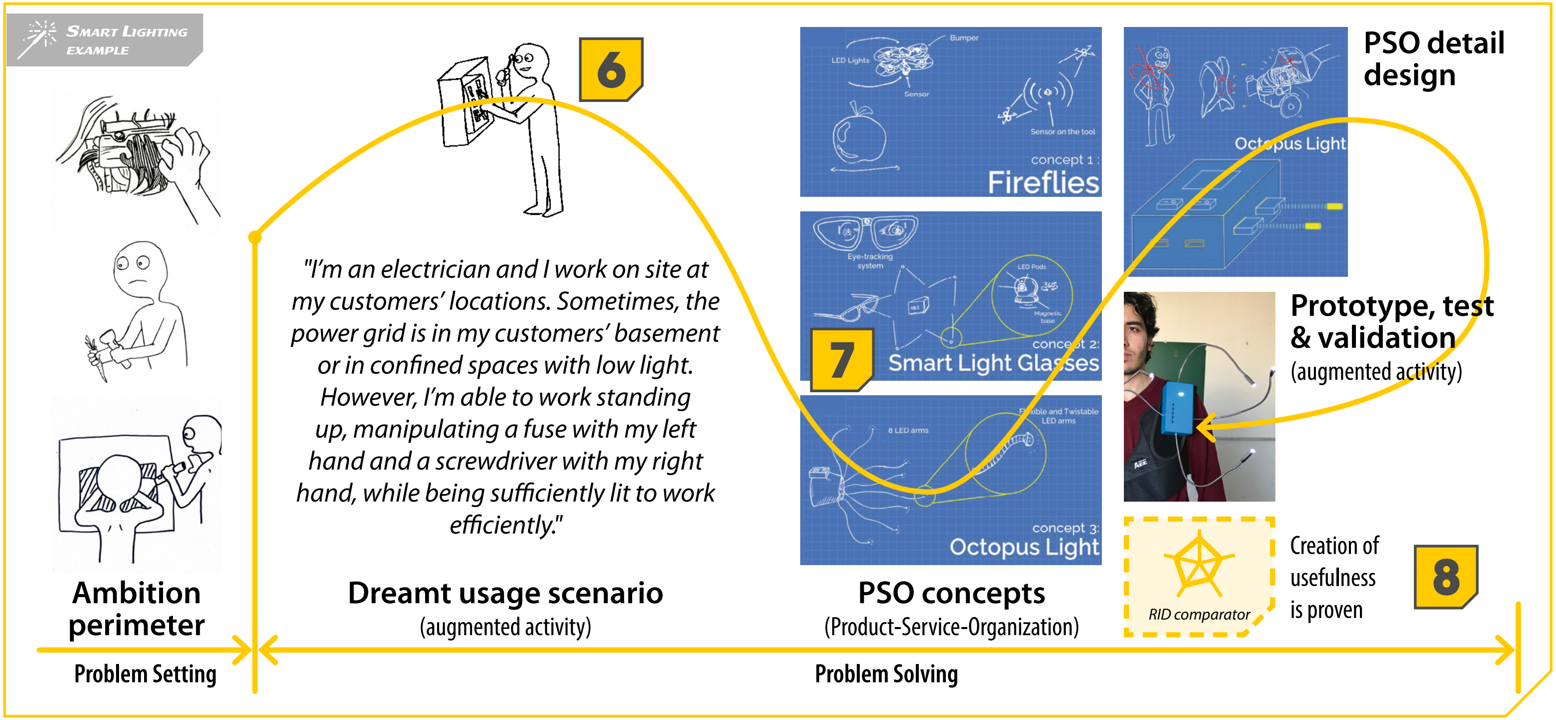
**Being well lit while manipulating an object precisely with both of my hands**



**Being able to manipulate an object precisely without the help of another person with a light**

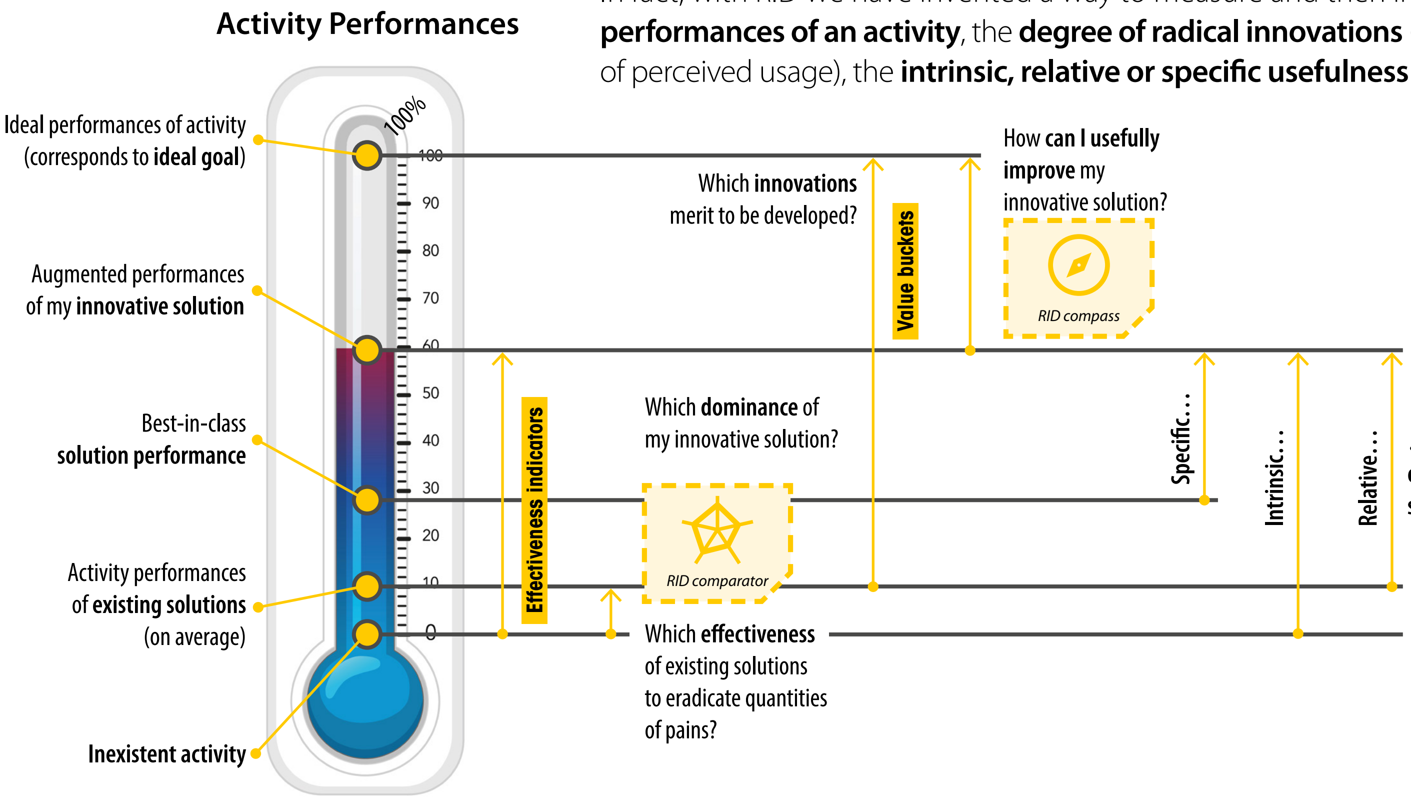
# 34 The problem solving process

**Problem solving** follows, guaranteeing the **traceability** of decisions.



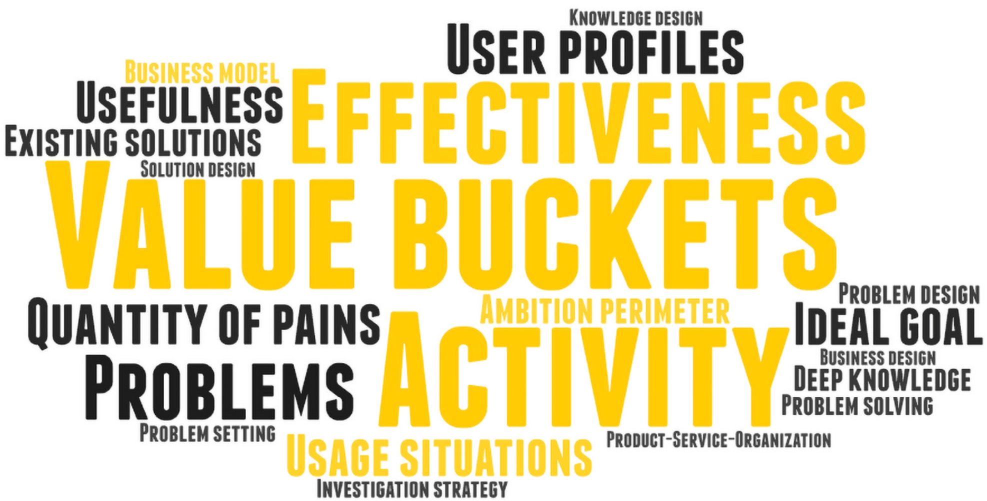
# 35 The scale of activity performances

In fact, with RID we have invented a way to measure and then improve the **performances of an activity**, the **degree of radical innovations** (in the sense of perceived usage), the **intrinsic, relative or specific usefulness** of solutions



# 36 Adapted concepts and vocabulary

RID introduces a **new vocabulary** of about 20 terms. These terms define **new concepts** (or constructs) and are used in new methods. This reflects the great richness and originality of the methodology.




**What's the best way to learn RID and master the RID concepts?**

- By reading this eBook!
- By playing the RID Serious Game in only 3 hours
- By registering to RID trainings

# Chapter 4

## Activity exploring

Which activity.ies to target?

# 37 How should you start innovation projects?

**Starting an innovation project** is usually triggered by an initial idea, motivation, request, objective.
Let us call it an **initial idea**.

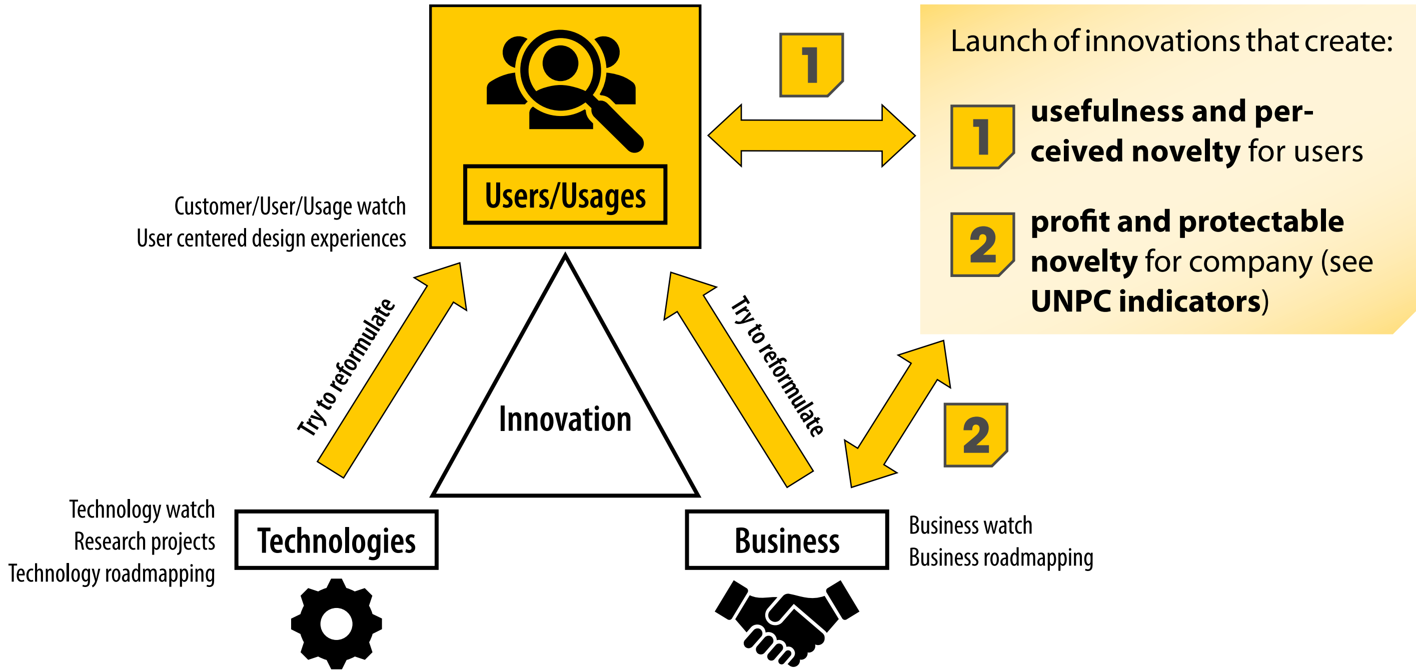
*But where can this **initial idea** come from?* It can come from any of the three domains:

- users/usages,
- technologies,
- business.

*But which **type of idea** would work best as a starting point for innovation?* From the RID **philosophy of innovation**, three rules must be respected:

- Try to formulate an **initial idea** in terms of a **problem** rather than in terms of a solution (see **nature of an idea**)
- Try to start with an **initial idea** from the user/usage domain. Indeed, it is best to innovate radically from the user's point of view, because launching an innovation should first create usefulness for users.
- Whatever the domain origin of the **initial idea**, it must be **reframed** into the user/usage domain as an **activity field** and an **ideal goal** of activity transformation. Then, the impacts on business and technologies are considered as consequences of the activity transformation.

## What should you start to innovate from?



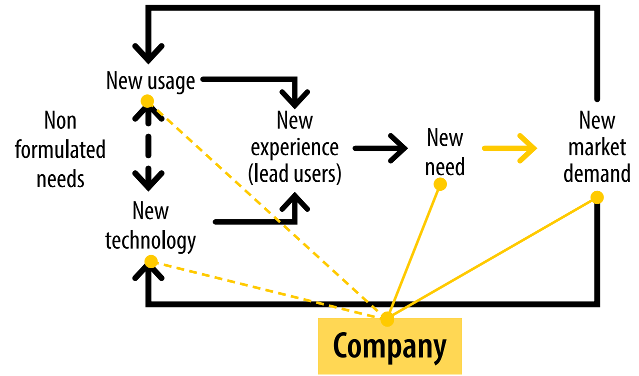

***SOURCE***
Bertoluci G., Yannou B., Attias D., Vallet E., 2013. A categorization of innovation funnels of companies as a way to better make conscious agility and permeability of innovation processes, In *ICORD: 4th International Conference on Research into Design*, January 7-9, Chennai, India.

# 38 The three innovation strategies

A study by Booz & Company reveals that companies follow at least one of the following **three innovation strategies**: **need seeker, market reader** or **technology driver**, depending on whether the **focus is on the customer, the market or the technology**, respectively [1]. According to this study, *"following a need seeker strategy, although difficult, offers the greatest potential for superior performance in the long term"*. RID is particularly well adapted to address need seeker projects, but it has been generalized for technology drivers in [2].

## Market reader strategy

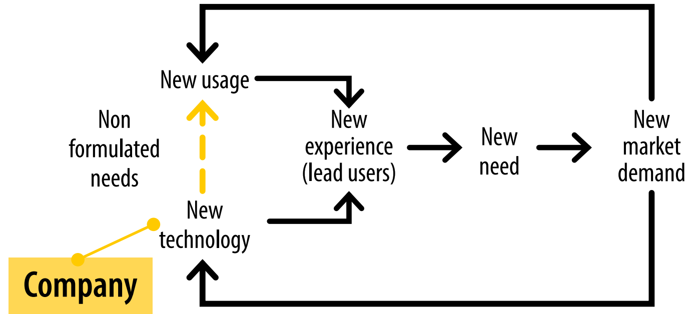
*"Companies use a variety of means to generate ideas by closely monitoring their markets, customers and competitors, focusing largely on creating value through incremental innovations"* [1]. Typical companies are Hyundai, Caterpillar, L'Oréal, Procter and Gamble. Here, observation of markets and usages can meet identified needs, possibly with new technologies and in renewing some usages.

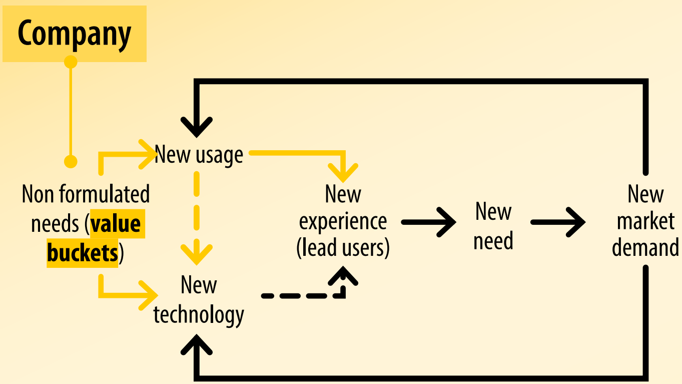



[1] Jaruzelski B, Staack V, Goehle B. Proven Paths to Innovation Success. strategy+business (Booz&Company) 2014;Issue 77.
[2] Bekhradi A., 2018. Planning technology maturation by exploration of useful problems in markets: The case of innovative startups. PhD thesis. Université Paris-Saclay.

## Technology driver strategy

*"Companies depend heavily on their internal technological capabilities to develop new products and services"* [1].
Typical companies are: Google, 3M, Bosch, Siemens.
Here, exploring research and technology can possibly lead to new usages.




## Need seeker strategy

With a **need seeker strategy**, *"companies make a point of engaging customers directly to generate new ideas. They develop new products and services based on superior end-user understanding"* [1]. The companies adopting a need seeker strategy are *"effective at both the ideation and conversion stages of innovation and they consistently outperform financially"* [1] (see this American study from 2012, completed by a French study in 2013).
These companies are, for example Apple (US), Dyson (UK) and Décathlon (France).
On the graph, the process starts with the detection of non-formulated needs, which corresponds to **value buckets** in RID.
Development in research and technology is then a consequence of this primary need exploration.

## Why is a methodology needed to support a need seeker strategy?

Because visionary leadership is predominant in the need-seeker mode, the support of a methodology like Radical Innovation Design is invaluable when you don't have a charismatic visionary on hand! Look at the omnipresence of Steve Jobs and James Dyson!

# 39 Nature of an idea

*"Ooh! I have an* ***idea****!"* is something that is hopefully expressed many times during an innovation project. In RID, an idea is characterized by its **nature** (**idea** of what?), and an idea of one nature inspires ideas of other natures along the **innovation process**. A RID process starts with an **initial idea** of any nature (1 to 9 from table beside). It is quickly **reframed** into a set of prioritized **value buckets** (natures 1 to 2) from which an **ambition perimeter** emerges (nature 3). The ideas then follow the transformation from 4 to 8.

## What can we do with an idea?

For any kind of idea, its **maturity** (certainty and impact) may be increased using the **UNPC monitor tool**. Ideas may be selected in companies (see **SAPIGE®**) for their ability to be positively transformed (see **UNPC innovativeness indicators**). Ideas may be **transformed** using a **creativity tool**.

## How to cope with "fuzzy" front-end innovation?

When starting an innovation project, we are always in a zone where we do not know what to do, as we do not have a rationale to logically determine what to innovate on. We are in the so-called **"fuzzy front-end of innovation"**; this is why **innovation methodologies** start their process with a "define" stage for Design Thinking, or "clarifying the task" for Pahl & Beitz. RID devotes an entire **"problem setting"** stage and argues that it is important to clarify the difference between ideas for problems and ideas for solutions (see **problem and solution co-evolution**).

| Nature of an idea | | RID concepts | | Smart lighting example |
|---|---|---|---|---|
| Problem | 1. User problem in an activity, pain, lack, dysfunction, dissatisfaction, irritant | Problem setting | Ideal goal (practicing an activity in an ideal manner) | *"Optimize vision comfort when performing a task/activity in the dark without restricting movement."* |
| | 2. Storytelling of some usage contexts and situations | | Activity segmentation into users, usages situations, problems | *"Some situations of do-it-yourselfers in the dark are apparently still problematic when they practice their activities."* |
| | 3. Desired improvements in an activity, new activity | | Value buckets, Ambition perimeter | *"Let us particularly innovate to avoid cast shadows while manipulating an object precisely with both hands"* |
| Solution | 4. Dreaming of a better world, of ideal services | Problem solving | Dreamt usage scenario | *"I'm now able to work standing up, manipulating a fuse with my left hand and a screwdriver with my right hand, while being sufficiently lit to work efficiently"* |
| | 5. New design principle | | Design principle | *Detection of hand positions and contours by digital cameras and processing* |
| | 6. New design brief, concept, structure of solution. Use of component. | | Product-Service-Organization (PSO) and Business Model (BM) concepts | *A kinematic architecture* |
| | 7. Detailed design solution and interaction scenarios | | PSO and BM detailed solutions | *Precise design of the lamp, including the component supplier selection and manufacturing process definition* |
| | 8. Precise business expectations | | Business plan | *"You must double your sales on lamp products by the end of year"* |
| | 9. Vague or futile business or company injunction | | Company objectives | *"You must do as well as our competitor"* |

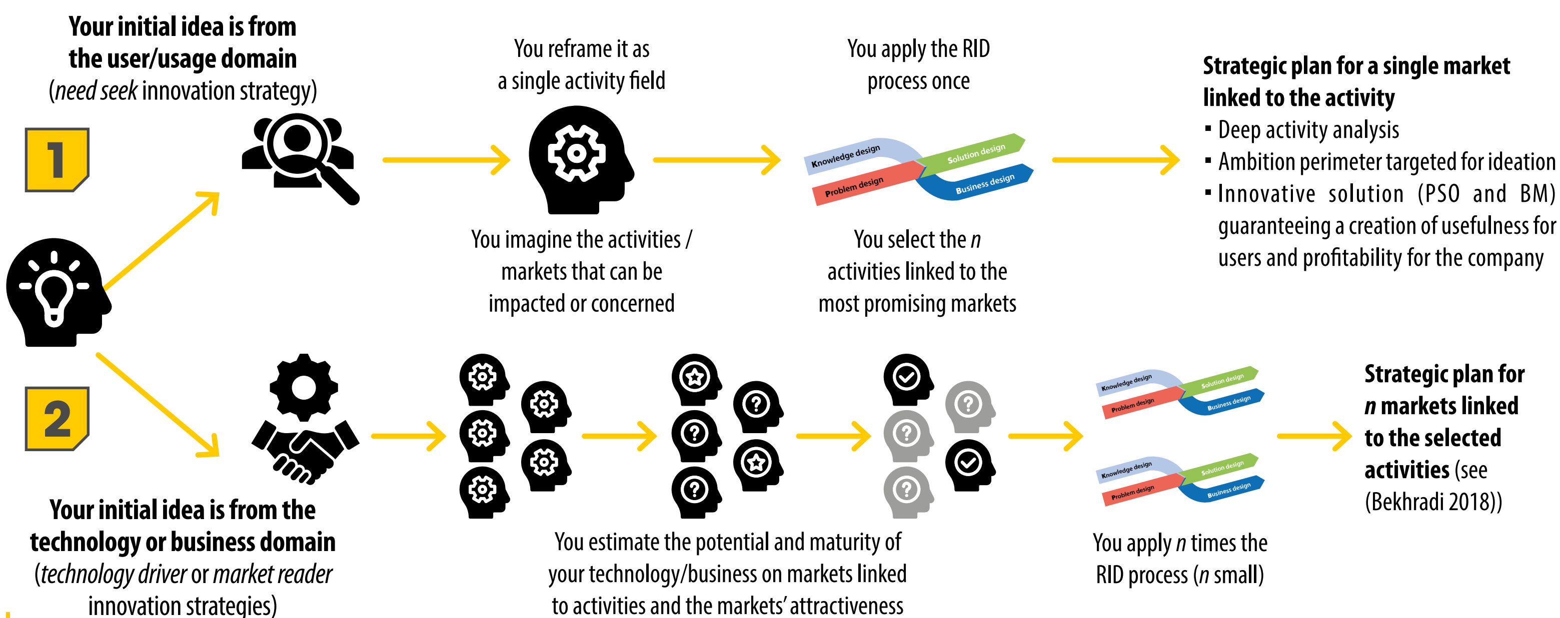

***SOURCE***

Motte D., Yannou B., Bjärnemo R., 2011. The specificities of radical innovation, *In ICoRD: 3rd Int. Conf. on Research into Design*, January 10-12, Bangalore, India.

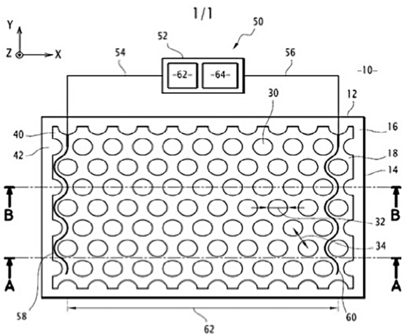
Pahl G., Beitz W., 1984. *Engineering Design*. The Design Council, London: Springer, ISBN: 978-0850722390.

# 40 What to do when your initial idea comes from the technology or business domains?

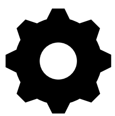
In RID, by default (outlined in *case #1* below), your initial idea is from the user/usage domain. But, in the case where your initial idea is from the technology or business domain (outlined in *case #2* below, and cf. example on the right-hand page), you must re-express your initial idea(s) into **one or several activities** of interest to investigate, leading to several RID studies in practice.



## Example of 2 an initial idea from the technology domain: *LOMA Innovation*

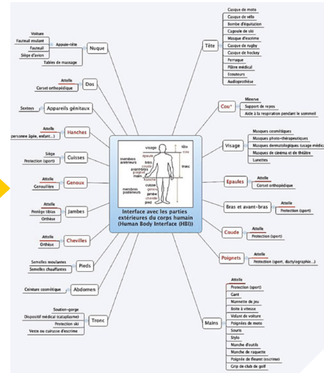



Innovate on products linked to body shapes using the LOMA technology



Patented shape-shifting technology

VIDEO LINK



Brainstorm on useful body shape applications

- Ability to cover bony parts of the human body
- Ability to immobilize parts of the human body
- Ability to cover foldable parts of the human body
- Adaptation to complex and polygonal surfaces
- Speed of shape shifting
- Practicality in terms of volume
- Hardness of the deformable surface
- Acceptability for a long-term contact with skin
- Ability to vary the thickness of the deformable surface
- Number of possible shape shiftings
- Possibility to set the heat threshold (thermal comfort)

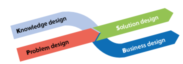
List the key properties of a shape-shifting technology linked to body shape applications

Fast selection of promising markets

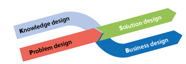
- M1) Cosmetic Masks
- M2) Shin Guards
- M3) Ski Boots
- M4) Orthopedic Insoles
- M5) Earphones

Evaluation of needed and *current* technology maturity for markets

Evaluation of markets attractiveness




Two RID studies




R&D activity

What LOMA innovation launch on the market

***SOURCE***

Bekhradi A. Planning technology maturation by exploration of useful problems in markets: The case of innovative startups. PhD thesis, Université Paris-Saclay (2018).

# 41 Activity field

The **activity field** is the delimitation of the **activity** that is involved in the RID project. It must be defined consistently in nature, space and time and possibly segmented in variants. As this delimitation may be highly variable, a guideline for defining an **activity field** consistently is to respect the **three unities of Classicism** as much as possible.

## Where/when in the RID process?

The **activity field** is defined along with the users you want to help. This task takes place at the beginning of the **problem design** stage of the **RID process**. It is defined from the **initial idea** and allows you to determine the **ideal goal**, thanks to the **reframing** task. To do it properly, you must have started the **investigation** in the **Knowledge design** process and know all the variants of the **activity**. Defining the **activity field** contributes to the process of **thinking inside the box**.

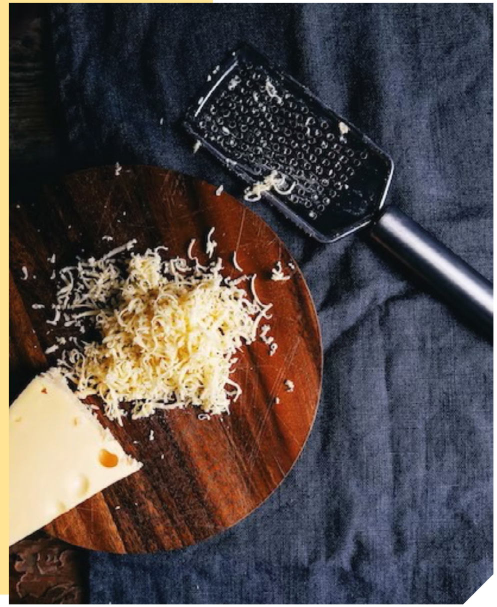
## The three unities of Classicism

According to Boileau, the action should take place within twenty-four hours (**time unit**) in one place (**unity of place**) and should be incorporated as a single plot (**unity of action**).

## Example: The activity field of a "cheese grater"

Let us imagine that the initial idea of a RID project is "to innovate on a cheese grater". This is obviously a bad **initial idea** as it refers to an **existing solution**. Indeed, one immediately thinks about the **activity field** of grating hard cheese with a specific type of grater. But can we imagine how to expand this standard activity field to **(a)** soft cheese (e.g. camembert), **(b)** to transform cheese other than grating, **(c)** to grate food products other than cheese (like vegetables, fruit peel, meat), **(d)** to file your nails or to rasp wood? Following the unities of Classicism, the answer is **YES for (a),(b),(c)** and **NO for (d)**:

- **Users**: people cooking for themselves
- **Time**: time to cook and enjoy the meal
- **Place**: kitchen
- **Action**: cooking preparation and mealtimes




The **ideal goal** of such an activity can be reframed into: *"Transform certain foods (cheese, fruit, vegetables ...) into small pieces of a certain size and shape in relation to my way of enjoying food and cooking..."*

***SOURCE***

Yannou B., 2011. Réexprimer un besoin idéal, *In Déployer l'innovation: Méthodes, outils, pilotage et cas d'étude, Les fiches pratiques - Edition 2011-2012 - Génie Industriel, eds. Paris: Techniques de l'Ingénieur, ISBN 978-2-85059-129-7, pp. 307-315.*

# 42 Ideal goal

**Initial ideas** are rarely well formulated, since they are more often a particular solution or an **idea** for the benefit of the company. Therefore, they must be transformed or reformulated into **ideal goals** (see **reframing**). The **ideal goal** is the ultimate innovation objective of the RID project. It is expressed relative to the **activity field** of particular users, **the objective being to allow users to practice their activity in an ideal manner**. To form an **ideal goal** properly, an investigation (see **Knowledge design**) must have been started on the practice of activity, possibly using **tools for reframing**. The **ideal goal** corresponds to the notion of jobs-to-be-done of C. Christensen.

## In practice, reframe the question in 4 steps

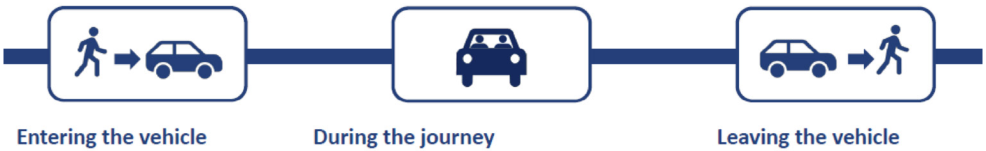
1. **Define who are the people you want to help in their activity:** consider only direct users and not stakeholders of a current economic value chain
2. **Define the fields of the activity in nature, space and time:** you must have started the **investigation** in the **Knowledge design** process and know all the variants of the activity
3. **Imagine what an ideal activity might look like:** you must have investigated all the expectations, key performance indicators, difficulties, usage conditions, psychological and sociological aspects surrounding the activity
4. **Formulate the ideal goal as a sentence with verb(s) and complements:** see advice for **reframing**

## Example: Ideal goal for the Accesseat project (by Faurecia, 2019)

*"The connected automobile seat for the safety of elderly people"* (idea proposed by the Innovation Manager in charge of car cockpit digitization)

Reframing with the 4 steps:

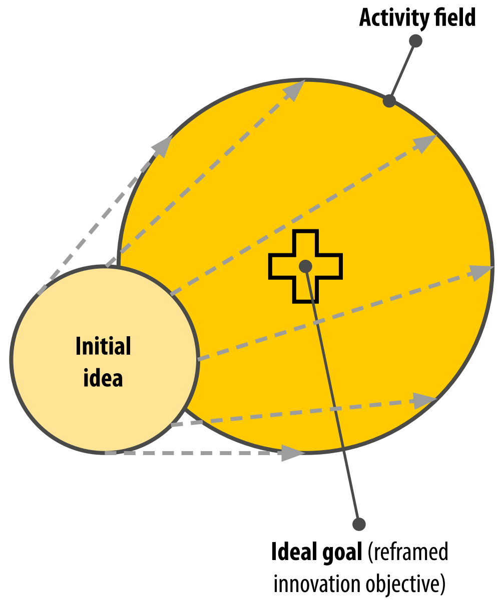
1. **Users:** Elderly between 62 and 85 who drive or cannot anymore
2. **Activity field:**




3. **Ideal activity:**

4. **Ideal goal**: *"Prevent, relieve and reassure elderly people as drivers or passengers before, during and after the car journey"*

### Reframing



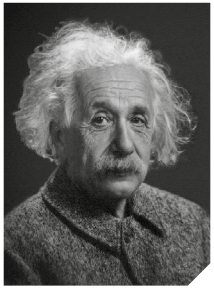


***SOURCE***

Yannou B., 2011. Réexprimer un besoin idéal, *In Déployer l'innovation: Méthodes, outils, pilotage et cas d'étude, Les fiches pratiques - Edition 2011-2012 - Génie Industriel, eds. Paris: Techniques de l'Ingénieur, ISBN 978-2-85059-129-7, pp. 307-315.*

# 43 Reframing - The two transformations to help formulate the ideal goal

**Reframing** involves reformulating the **initial idea** into a more legitimate innovation question: the **ideal goal**. It is of the utmost importance to fix a valuable, consistent and ambitious target in the **fuzzy front-end of innovation**. **Reframing** allows you to define a legitimate box perimeter for **thinking inside the box**. Two tools "flow transfer" and "transformation" help the **reframing process**.



**Why formulating good questions is so important?**

*"If I had an hour to solve a problem and my life depended on the solution, I would spend the first 55 minutes determining the proper question to ask, for once I know the proper question, I could solve the problem in less than five minutes."*

Albert Einstein

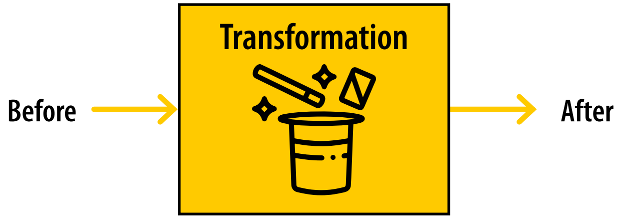
## Where/when in the RID process?

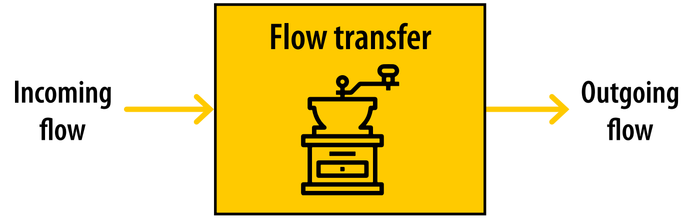
**Reframing** takes place at the beginning of the **problem design** stage of the **RID process**. It is defined from the **initial idea** and allows you to determine the **ideal goal**. To do it properly, you must have started the **investigation** in the **Knowledge design** process and know the goal, conditions and variants of the **activity**.

## Formulating a relevant question in the fuzzy front-end

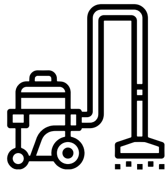
Reformulating the innovation question/challenge must allow you to compare with previous company choices (product portfolio, markets, brand image, core competencies, industrial ecosystem…) and to position with **strategic marketing** plans to work out if the question corresponds to identified **growth territories** for the company.

## Two tools for formulating the ideal goal




**Example: For what purpose…**

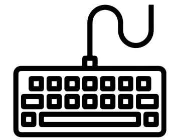


*"Removing dust from a room and the objects therein"*

Dust is defined in the broad sense: organic residues, skin, hair, dust mites, soil, particle size ⩾ x microns, marks, pebbles size < xx mm, liquid. Rooms and objects are considered in a broad sense: flooring (lino, carpet, parquet, tiles, cement slab), ornaments, surfaces that can be uneven, mattresses... Remove dust or wash, remove stains, clean?

This formulation allows us to envisage designing the Dyson DC36 Allergy Parquet which harvests allergens such as pollen, mold, mites and bacteria.

**Example: For what purpose…**



*"Transforming a combination of body signals (coding) into a series of 512 discrete codes (ASCII table) in the form of electrical signals respecting standard ISO-8859 (the ASCII table - American Standard Code for Information Interchange – was invented in 1961 and standardized in 1986)"*

This formulation allows us to envisage designing keyboards like the ones already designed for blind or myopathic people, as well as virtual keyboards.

**SOURCE**

Yannou B., 2011. Réexprimer un besoin idéal, *In Déployer l'innovation: Méthodes, outils, pilotage et cas d'étude, Les fiches pratiques - Edition 2011-2012 - Génie Industriel, eds. Paris: Techniques de l'Ingénieur, ISBN 978-2-85059-129-7, pp. 307-315.*

# 44 Reframing - The two tables that make the ideal goal robust

The "*For What Purpose*" table is a series of 3 questions: (1) Why? (2) For what purpose? (3) How permanent is the goal? The answer to "*For what purpose*?" provides the **ideal goal**, the other two questions are prompts to assess the value of this goal and its permanence over time. These three questions allow us to consider the necessary buildup in competences and knowledge by the project team.

| Initial idea | Develop a new toothpaste |
|---|---|
| **Why?** Response: **Because… there are problems.**<br>They are the reasons or causes. | **Because…** *oral cavities cause multiple hygiene and health problems* |
| **For what purpose?** Response: **For… solving some or all of these problems.**<br>It is the **ideal goal** regardless of the specific circumstances of the project and the company. This object has a strong legitimacy. | **For…** ***solving all the problems of hygiene, oral health and comfort***<br>This is the **ideal goal**! |
| **How permanent is the goal?** Will these problems addressed by the ideal goal evolve or disappear in the short term? | **How permanent is the goal?** No, it seems that hygiene and oral health issues are sustainable. No technology or changes in lifestyle seems to question this need. |
| **Buildup in competence and knowledge** of project team. It must be related to the reasons / causes and goals discussed. | 3 lots of study can be initiated to feed the understanding of the **ideal goal** on the chemistry of the mouth, health / medicine and comfort. |

## "For what purpose?" table (left page)

It is therefore evident that a "toothpaste" is only a particular solution to the ideal goal for oral hygiene and health. Together with a toothbrush, this involves reducing certain risks through a mechanical effect on teeth and gums. It should be noted that even a traditional manufacturer of toothpastes or toothbrushes has a lot to gain by knowing and documenting the aforementioned ideal goal, because it is not that expensive to document the physio-chemistry of the mouth and the oral cavity (see **deep knowledge**); this is the foundation of any future innovation.

## "Purpose consolidation" table (right)

It is not always easy to find the ideal need by directly answering the question ***"for what purpose do we need a computer keyboard?"***. Practice in a table to propose several alternative answers. For each of the alternative answers, propose other solutions that meet this goal. You will quickly notice that your formulation is either too weak because it covers too many goals or, conversely, too specific. Another golden rule is to define the scope of the **ideal goal** by allowing yourself to describe what is outside this scope (e.g. There is no question of modifying the ASCII code) as precisely as possible, without mentioning what is inside this boundary.


**SOURCE**

Yannou B., 2011. Réexprimer un besoin idéal, In Déployer l'innovation: Méthodes, outils, pilotage et cas d'étude, Les fiches pratiques - Edition 2011-2012 - Génie Industriel, eds. Paris: Techniques de l'Ingénieur, ISBN 978-2-85059-129-7, pp. 307-315.


| Spontaneous answer | Other solutions for this need | Comments and golden rules |
|---|---|---|
| *Communicate or transmit information* | Mouth, telephone, gestures | It is an over-generalized or all-purpose word. Its semantics are too weak, too uncontextualized. As a result, the wording is too indiscriminate. |
| *Be an interface with the computer* | Mouse, microphone, loudspeaker, touch screen, wifi/bluetooth/infrared | Same as above |
| *Facilitates writing* | Pen | The wording is too indiscriminate and, at the same time, too precise. Indeed, a computer keyboard not only allows writing but also other types of data transfer. |
| *Allow writing on a computer* | A keyboard can also be used to play action games | The wording is too precise. |
| *Recording data* | Microphone, MP3, human memory | The semantics are too weak. |
| *Using fingers to transmit information* | Drum, eye-tracking virtual keyboards | The wording is too indiscriminate. The formulation refers to a particular solution (use of fingers) and therefore hinders the exploration of possibilities. |

# Chapter 5

## Knowledge design

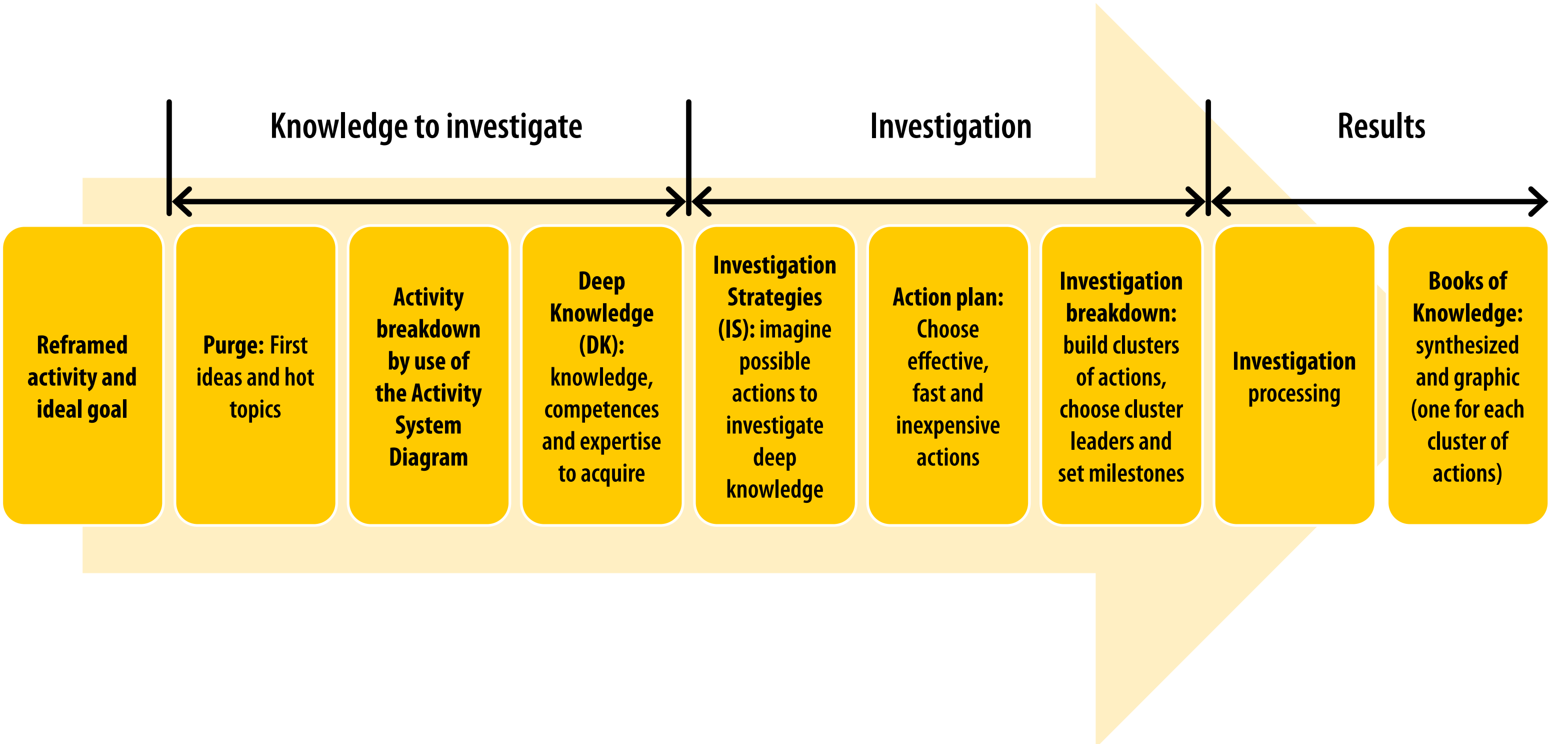
# 45 Knowledge design

**Knowledge design** is one of the 4 fundamental sub-processes of the **RID process**. It allows the innovation project to start with a multidisciplinary group in an organized way. Three results are produced: (a) an outline of the knowledge, competences and expertise relevant to the project, (b) an increase in this **deep knowledge** through efficient **investigation** strategies and action plans, (c) the whole resulting in the writing and presentation of **books of knowledge**.

## Objectives

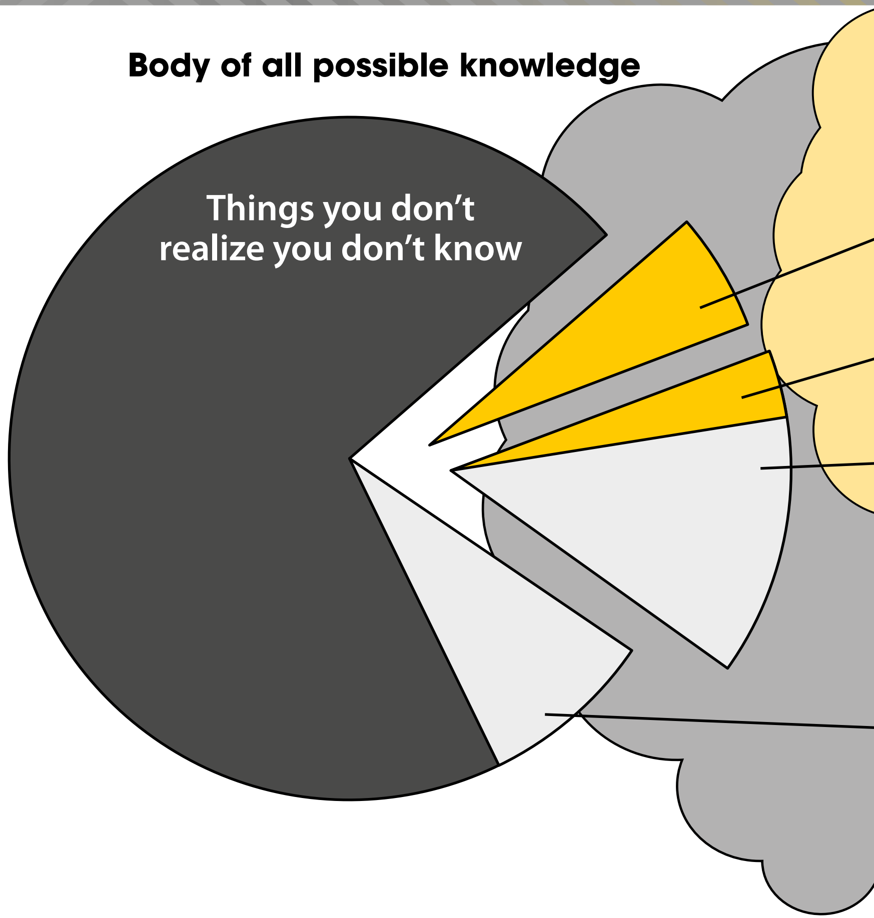
1. Build up in competences and knowledge in an innovation team
2. Identify key knowledge (areas of activity, problems, "pains", (non-)users, needs, trends...), especially knowledge linked to new innovation levers (**deep knowledge**), exploring beyond traditional competition studies
3. Feed into the **problem formulation and the solution search**
4. Effectively manage the first stages of the innovation project (with tasks, responsibilities, deliverables, deadlines) which are generally loose in the **fuzzy front-end**
5. Build a shared memory for providing a shared understanding of the phenomena and stakes involved, and forge a common business language to innovate together and on fundamental issues
6. Ensure this work remains available for future projects and may even be used for setting goals or prioritizing R&D projects of the company (see **traceability**)
7. Adopt a collaborative attitude for innovation (see **behavioral charter**)

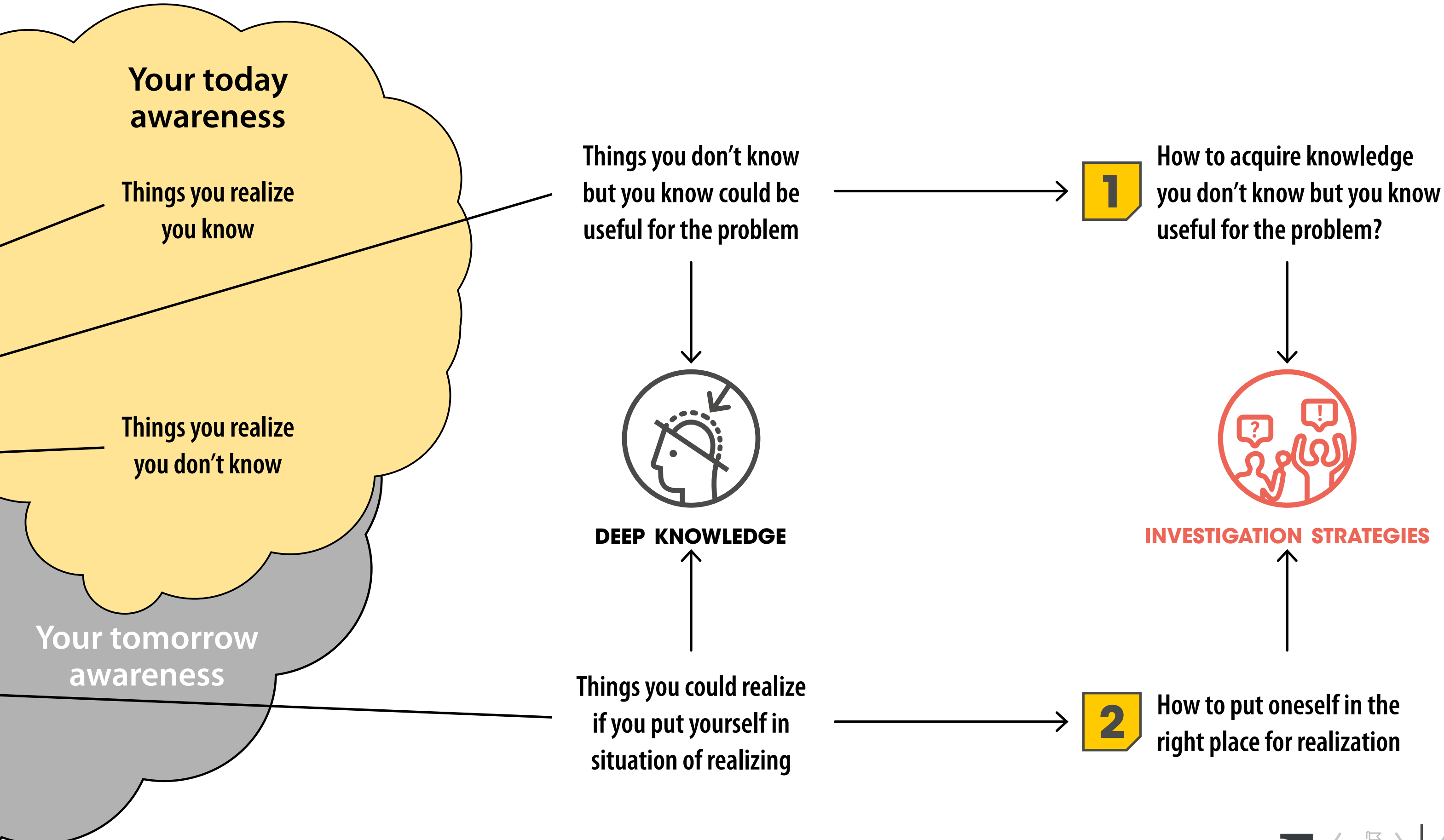
## Knowledge design detailed process



# 46 Consciously extending your awareness of the problem

The objective of a RID Knowledge design process is to **extend as far as possible your awareness of the problem** at innovating within the boundaries of an activity. This is achieved by capturing non-trivial (deep) knowledge and putting oneself in fruitful investigation situations (strategies).

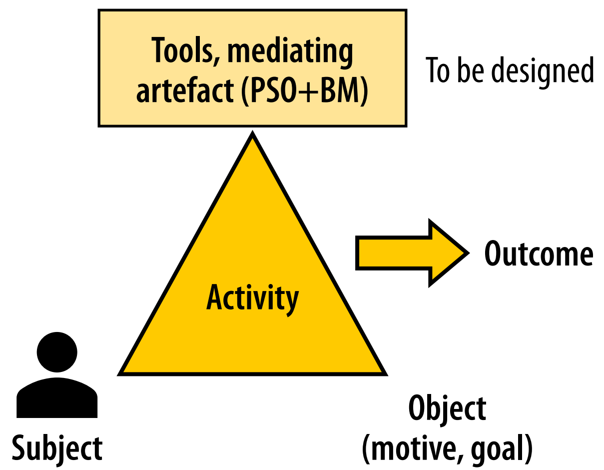



Your today awareness
Things you realize you know
Things you realize you don't know
Your tomorrow awareness
Things you don't know but you know could be useful for the problem
1
How to acquire knowledge you don't know but you know useful for the problem?
DEEP KNOWLEDGE
INVESTIGATION STRATEGIES
Things you could realize if you put yourself in situation of realizing
2
How to put oneself in the right place for realization

# 47 Activity theory

Psychologists developed **activity theory** to (1) describe and understand an individual activity (Vygotsky), and (2) consequently an **activity system** (Engeström). Next, design ergonomists (Rabardel, Daniellou, Darses, Barcellini, Engeström) proposed approaches for designing an **activity system**. Several scientific trends also consider human activity in design tasks, such as: human-computer interaction (HCI), human-system integration (HSI), **activity-centered design** and user experience (UX) Design.

**1** A Russian school of psychology first developed **activity theory**. Vygotsky's framework is individually focused. For an activity (made of tasks or actions), a subject use tools, following a goal, to produce an outcome.



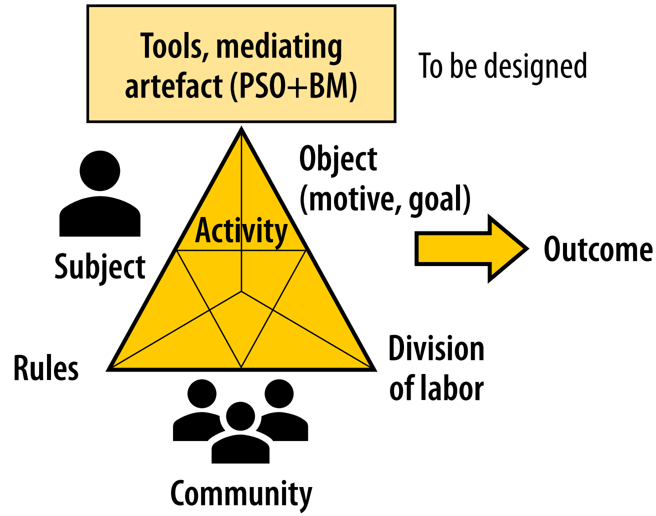
For the users' benefit, RID proposes considering all design issues within the framework of **activity-centered design**. The results of a design, whether they are Products-Services-Organization and Business Models (PSO+BM), are the tools or mediating artifacts of the activity theory that allow an activity to be carried out with good performance.

RID uses the activity system diagram of Engeström [2] as a **breakdown structure** to investigate the existing activity that needs to be improved.

**SOURCE**


Engeström Y., Miettinen R., Punamäki R.-L., 1999. *Pespectives on activity theory*, Cambridge, UK: Cambridge University Press, ISBN: 978-0521431279.
Rabardel, P. 1995. *Les hommes et les technologies; approche cognitive des instruments contemporains*. Armand Colin.
Barcellini, F., Van Belleghem, L., and Daniellou, F. 2013. Les projets de conception comme opportunité de développement des activités. Ergonomie constructive, Presses universitaires de France. p. 191–206.
Daniellou, F. 2004. L'ergonomie dans la conduite de projets de conception de systèmes de travail. In P. Falzon (ed.). Ergonomie, Presses Universitaires de France. p. 359–373.
Darses, F., Falzon, P., and Munduteguy, C. 2004. Paradigmes et modèles pour l'analyse cognitive des activités finalisées. Ergonomie, Presses Universitaires de France. p. 191–212.


**2** A Scandinavian school of psychology (Engeström, 1999) extended **activity theory** to consider activity systems. The social aspects of work are considered alongside community, rules and division of labor.

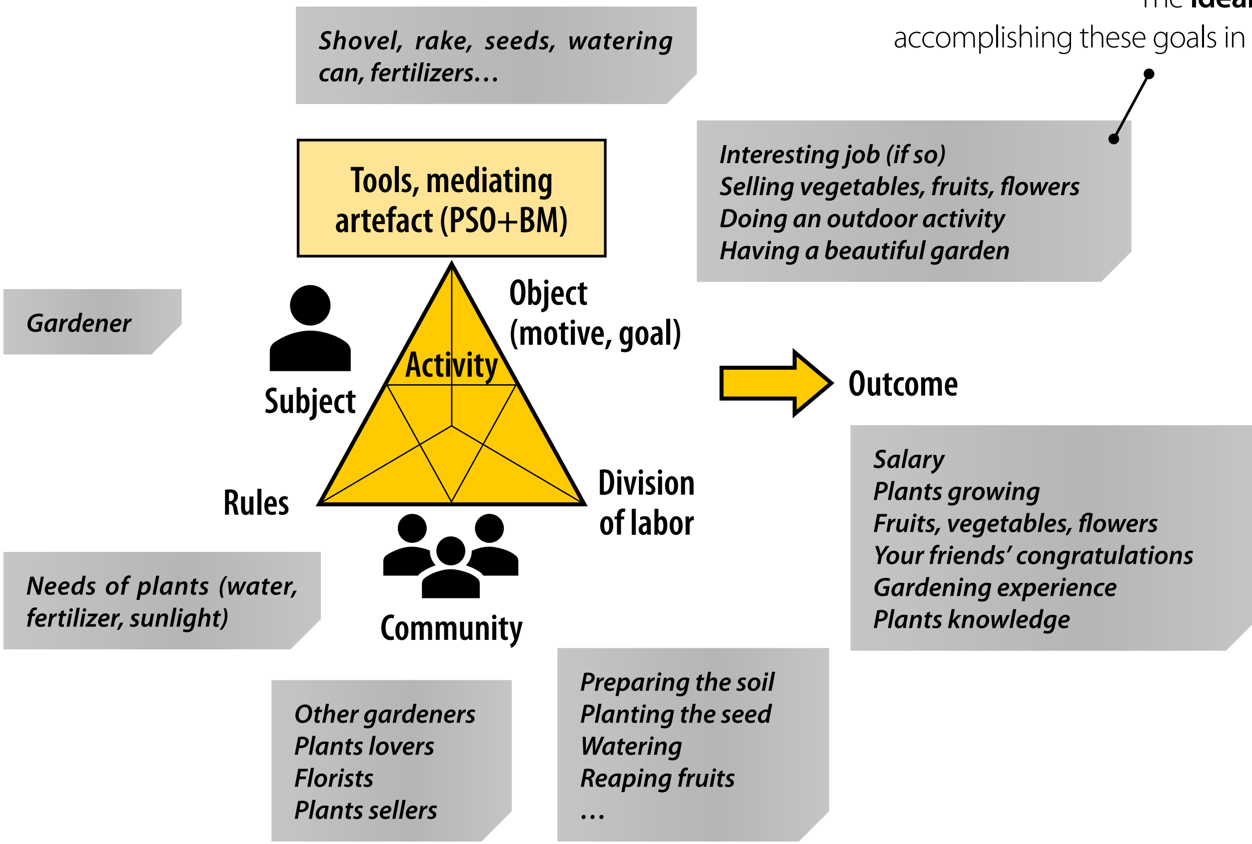


# 48 Activity breakdown

If you want to analyze today's activity to design the future activity, you need to know what that activity is made of. We use Engeström's activity system diagram to **break down an activity** into observable components, which in turn serve as the basis for imagining the knowledge and skills to be investigated and acquired.

## Example of a *gardening activity*

The **ideal goal** consists in accomplishing these goals in an ideal manner



# 49 Deep knowledge

A **Deep knowledge** (DK) is all the useful information related to the **design of the problem**. It is all the knowledge you would have if you were omniscient. In particular, it is any information to do with **user activities**, or that would formulate an innovation lever. A **Deep knowledge** often refers to scientific disciplines such as medicine, biology, psychology or sociology.

## Deep knowledge creativity session

The creativity session conducted for gathering DK in the **Knowledge design** process is driven by the idea: "*picture what you would like to know*".
DK items are selected or not for further **investigation** considering the tradeoff between their priority and their time and cost of acquisition. The *"Design your Knowledge"* board serves this purpose.

## Example of Deep knowledge

Imagine that the **ideal goal** of an innovation project is to "eradicate dandelions from an individual's lawn". An obvious DK item would be:

- *different ways to eradicate dandelions: mechanical, chemical, heat/fire, bugs…*

But don't forget to investigate:

- *finding the best botanical research on growth and diseases of the dandelion,*
- *different ways of valuing dandelions.*

## Deep knowledge (DK) checklist

What are we looking for?

- **Usage** (**activity fields** or existing usages and practice(s); user habits, cognitive processes, states of mind, experiences, stakeholders other than users..., **usage situations** and contexts)
- **Problems** / **"pains"** / dissatisfactions / frustrations / lacks in performance / needs... and, conversely, satisfactions, expected values, activity KPIs…
- **Consequences** of the problems
- **Causes** of the problems

What already exists?

- **Benchmark** of **existing solutions** and technologies
  - What are the existing or emerging products / services for the identified ideal goal?
  - Marketed solutions / costs
  - Technologies (maturity, manufacturers, quality, patents, costs...)
  - Scientific issues and expertise
- **Market survey and business models**
  - What are the innovations / manufacturers / strategies / markets / product lines?
  - What expertise do the customers and the sellers have? Or partners with an **open attitude of innovation**
  - Which **innovation strategies**?
  - Which network of people inside and outside the company?
- **Effectiveness and efficiency** of these **existing solutions**, technologies, markets and **business models**

***SOURCE***
Yannou B., Lamé G., Cluzel F., 2018. Adapting the FBS model of designing for usage-driven innovation processes, *In IDETC/CIE 2018: International Design Engineering Technical Conferences / CIE: Computers and Information in Engineering, August 26-29, Quebec City, Quebec, Canada.*

# 50 Investigation strategies

Once the **deep knowledge** (DK) items have been obtained in the **knowledge design** process, **investigation strategies** (IS) must be constructed to increase skills and knowledge effectively.

A **checklist** is designed to encourage people to think from different perspectives.

**Investigation** is processed only for essential **deep knowledge** items for which **investigation strategy** is economical in time and cost, and results in clear information acquisition. Once completed, investigation results are reported in **books of knowledge**.

## Vocabulary and mindset

Use the vocabulary of **criminal investigation** (**clues** and **evidence** once accumulated are transformed into **proofs and facts** vs. **presumptions**) and **scientific method** (**hypotheses** are formulated and **trialed** before **conclusion**). Put yourself in the shoes of an **investigator or a researcher** and adopt their **behavior** (perspicacity) and their methods (illustrated **notebook** for **collecting information** as well as **keeping a trace of cognitive pathways**, field investigation strategies and short micro-investigation sequences made of hypothesis-experiment-conclusions).

### The scientific method

1. Question
2. Hypothesis
3. Experiment
4. Result
5. Conclusion

## Investigation strategies (IS) checklist

- Watch
  - Access and read document inside/outside company
  - Find an expert
  - Professional exhibition
- Interview/survey of users/experts
- Model and simulate
- Assess
- Experiment
- Prototype

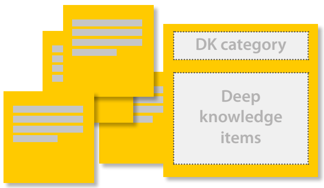
***SOURCE***

Lamé G., Yannou B., Cluzel F., 2018. Analyzing RID methodology through the lens of innovative abduction, *In International Design Conference*, May 21-24, Dubrovnik, Croatia.
Yannou B., Lamé G., Cluzel F., 2018. Adapting the FBS model of designing for usage-driven innovation processes, *In IDETC/CIE 2018*, August 26-29, Quebec City, Quebec, Canada.

# 51 "Design your knowledge" board

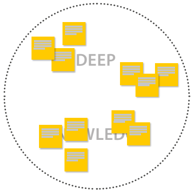
## Design your knowledge!

**1**



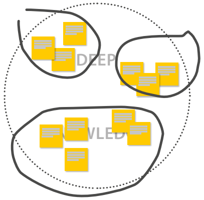

Each participant must find the maximal number of Deep Knowledge items in relation with the innovation topic in 5mn. Write them on post-it notes (one idea per post-it) and indicate the Deep Knowledge category of the checklist.

**2**



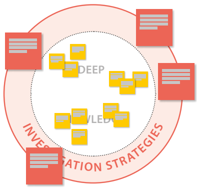

Place all your post-its in the inner circle of the template. They can be reorganized, deleted or merged. New post-it notes can be added along the team brainstorming.

**3**



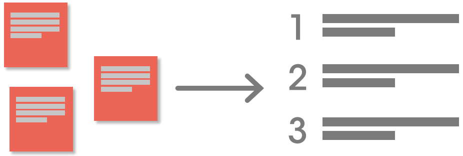
The clusters of Deep Knowledge notes constitute a "Deep Knowledge bag" to dig in.

**4**




With post-it notes of another color, your team must now define a set of Investigation Strategies that you place in the outer circle of the template. You can use the "Investigation Strategy" checklist for inspiration and for categorizing an appropriate action/strategy that may be useful to investigate one or more Deep Knowledges. Relate each Investigation Strategy to the subset of investigated Deep Knowledge items.

**5**



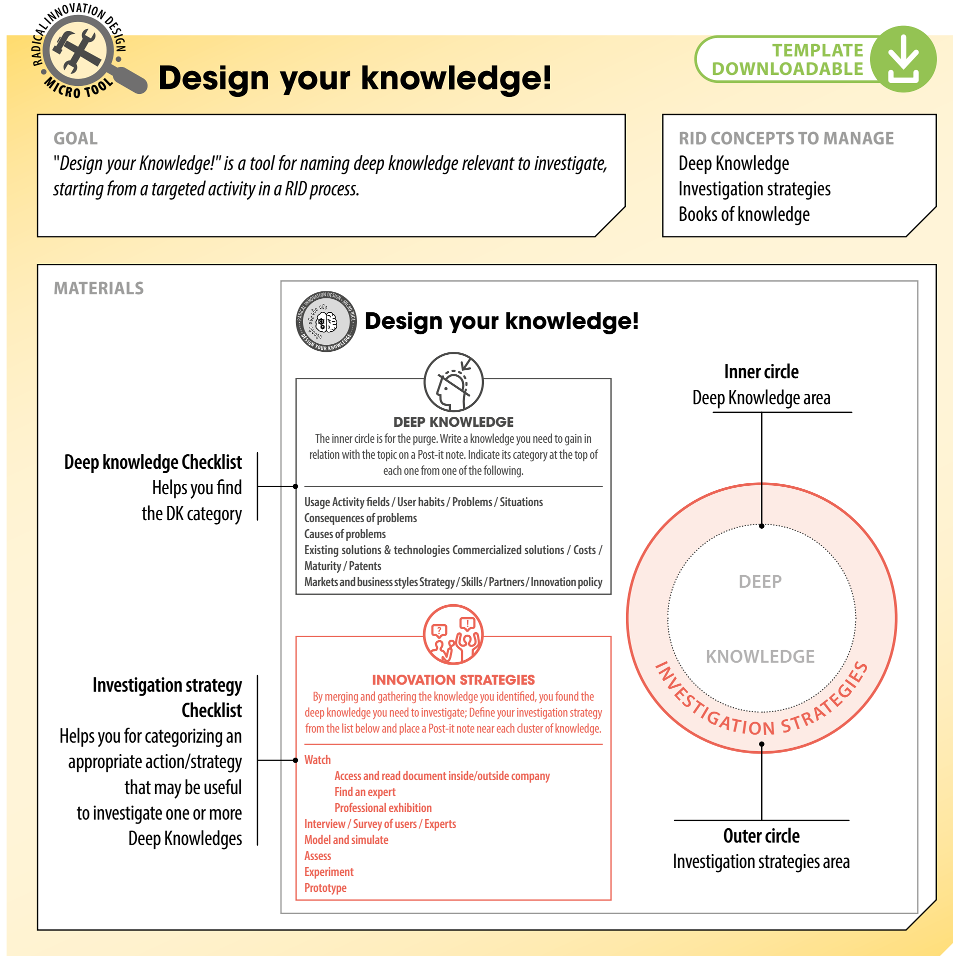

Gather "Investigation Strategies" which logically should be considered together and administrated by the same project leader and sub-team. The so-called Investigation Breakdown pieces are assigned to a project leader and a sub-team. Each sub-team must now produce a corresponding Book of Knowledge within the planned duration. Name it and recapitulate the order of actions/strategies to undertake for that purpose.

## Given that:

- Each Investigation Strategy (IS):
  - has a **duration**
  - has a **cost**
  - is likely to provide more or less **reliable information/response** to the concerned deep knowledge
  - **contributes differently** to the acquisition of knowledge or not
  - is compatible with the existing or expected **open innovation network** of the company
- **Time and human resources** are limited
- Deep knowledge are of **relative relevance** to be innovation levers

## Then:

- A **tradeoff** is made to select a portfolio of Deep Knowledge items and Investigation Strategies to investigate
- This tradeoff is necessarily **controlled** and **monitored**



# 52 Observation of usage

In an activity-centered design approach, it is imperative to understand past and present usages, users' motives, goals and behaviors, and interactions with existing solutions, other users and communities, in a representative set of contexts. This is why **observations of usage** must be performed for this purpose. Different observation techniques exist. Adequate observation protocols must be defined so as, after the results analysis, to collect the necessary information specified during the knowledge design sub-process (see also representations of usage).

**Observation techniques**

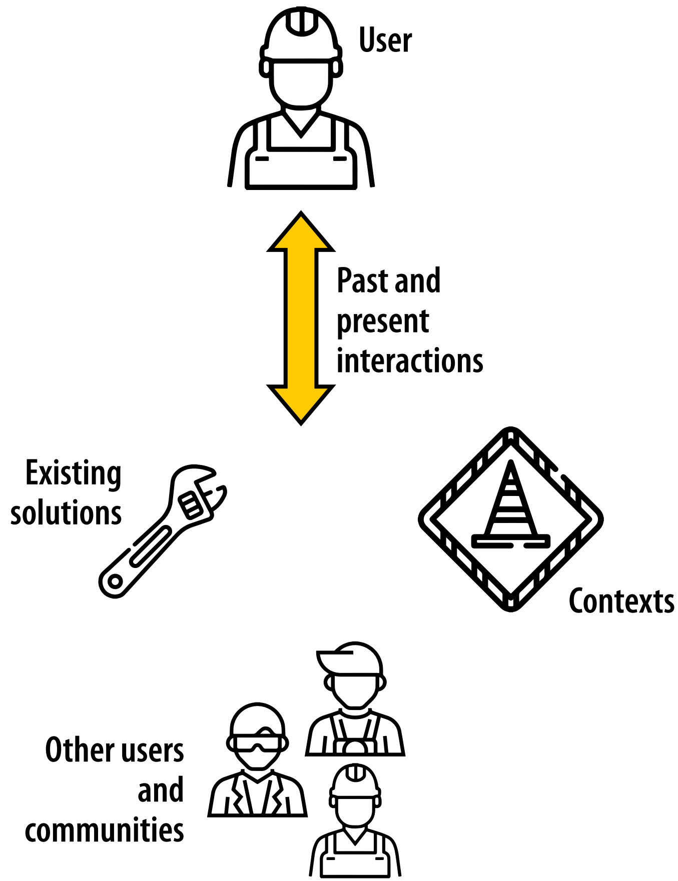
- Interview / Questionnaire
- Day in the Life / Shadowing
- Empathy Tool
- Design Probe / Prototyping
- Scenario / Persona
- User Forum / Focus Group
- Participatory Design Game

**To observe is either:**

- To receive knowledge of the outside world through the senses
- To record data through the use of scientific instruments

**Definition of usage [Merriam-Webster]**

- 1a: a firmly established and generally accepted practice or procedure
- 1b: a uniform certain reasonable lawful practice
- 1c: the way in which words and phrases are actually used in a language community
- 2a: the action, amount, or mode of using
- 2b: manner of treating




*SOURCE*

Yannou B., Cluzel F., 2015. Observer et représenter des usages, In *Déployer l'innovation: Méthodes, outils, pilotage et cas d'étude*, Les fiches pratiques - Edition 2011-2012 - Génie Industriel, eds. Paris: Techniques de l'Ingénieur, ISBN 978-2-85059-129-7.

# 53 RID template for observation of usage

In RID, we proposed an adapted observation template for qualifyng and quantifying usage situations.

## Define protocol

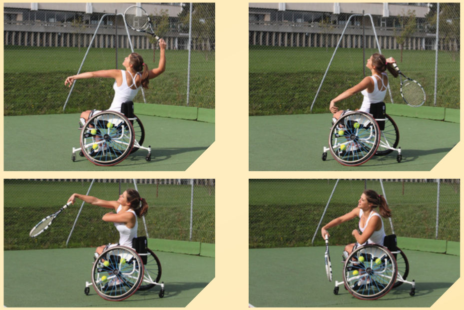
- **Define the purpose of the observation**
  - Why observe?
  - What is the context?
  - Who/what do you observe, doing what?
- **List the variables to be measured**
  - What do you **quantify?**
  - Also include any physical phenomena you expect to observe
- **Define a set of experiments**
  - What equipment?
  - Who should be involved?
  - How to represent the results?
- **Define and fill your own observation sheets**

RADICAL INNOVATION DESIGN MICRO TOOL

TEMPLATE DOWNLOADABLE

### Observation sheet (1/2): Tennis wheelchair project

*Emmanuelle Mörch is a professional wheelchair tennis player.*



**Observation context**
It is Emmanuelle's turn to serve. She stops before throwing the ball. She prepares: one hand holding the ball, the other holding the racket. The racquet makes its movement behind her back and hits the ball high.

**What do you quantify?**
Chair movement, wheels moving, number and percentage of successful services, ball speed

**Problems, failures, shortcomings, needs...**
A rotation around the vertical (twist) is observed when she strikes the ball. Service is probably less effective because a power loss of the ball probably occurs.

## Analyze results

- **List the results of each experiment**
  - On the variables (quantitative)
  - On the phenomena (qualitative)
  - Comments on the report
- **List problems ("pains" and "gains")**
  - What problems have been identified?
- **List the limits**
  - How can we improve future observations?

*SOURCE*

Yannou B., Cluzel F., 2015. Observer et représenter des usages, In *Déployer l'innovation: Méthodes, outils, pilotage et cas d'étude*, Les fiches pratiques - Edition 2011-2012 - Génie Industriel, eds. Paris: Techniques de l'Ingénieur, ISBN 978-2-85059-129-7.

RADICAL INNOVATION DESIGN MICRO TOOL

# Observation sheet (2/2): Tennis wheelchair project

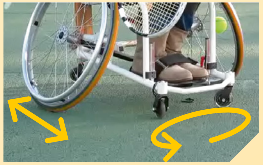
TEMPLATE DOWNLOADABLE

### Investigation process

Coaches of Handitennis said that 80% of services in Hantennis are winners!

### Observation protocol

Filming user (Emmanuelle) serving. We measure the movement of the front wheels and the speed of the ball (decomposition of film images). The material used is a camera. 3 situations are tested: wheels unlocked, one wheel locked, 2 wheels locked.

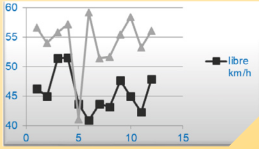


### Observation results

**Unlocked wheels:** important twist, Emmanuelle has become accustomed to a precision correction

**1 locked wheel:** 9% more speed

**2 locked wheels:** 19% more speed, increased precision in a few hours.



# 54 Representation of usage scenarios

In a **usage-driven design** approach, two types of **usage scenarios** must be **observed** and **represented**: the **existing scenarios**, and the new ones (**dreamt**).The **representation techniques** and the **script** must be chosen appropriately to exhibit the challenges embodied by the **value buckets**.

### Script for existing scenarios

Two types of scripts can be distinguished

- **A script related to an existing usage, outside any specific existing solution**
  - What are these usages/practices?
  - Who are the people involved?
  - How many people does it affect?
  - Which typical usage situations and problems are concerned?
- **A script linked to an existing solution (responding at least partially to the ideal goal)**
  - What are the existing solutions?
  - What are their market shares?
  - Which problems/needs does this solution address?
  - How efficient is this solution?

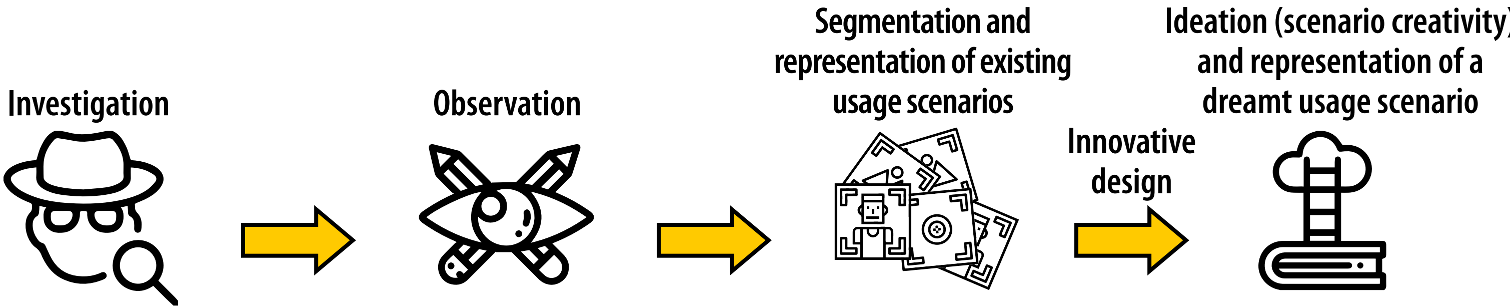
**The script must enhance usages that are not covered or poorly covered by existing practices or solutions.**

### Script for dreamt usage scenarios

It must show how important **value buckets** are addressed through a narrative.

RID STUDY DOWNLOADABLE

## The process of representing usage scenarios: The AutoNOM RID study




AutoNOM is a RID project conducted by an orthopedic and trauma surgeon specializing in neuro-orthopedics (surgery for orthopedic deformities due to neurological pathology) of Paris Hospitals. For people living in long-term care facilities or elderly people living in medical deserts, access to healthcare professionals, technical platforms or innovative therapies is difficult. After analyzing the lack of care of these people, the RID study helped the medical doctor to imagine and design a brand-new mobile unit for the care of highly dependent patients directly in their living environment.


Video illustration (stop motion technique) of existing usage scenarios

Video illustration (stop motion technique) of a dreamt usage scenario

***SOURCE***

Yannou B., Cluzel F., 2015. Observer et représenter des usages, In *Déployer l'innovation: Méthodes, outils, pilotage et cas d'étude*, Les fiches pratiques - Edition 2011-2012 - Génie Industriel, eds. Paris: Techniques de l'Ingénieur, ISBN 978-2-85059-129-7.

# 55 Representation techniques for a usage scenario

Many **techniques** can be used to embody a usage scenario. The simplest ones are **text** (storytelling of an activity), **sketches** and **movies** (with actors who are project members). But consider more sophisticated options, like **rough**, **storyboards**, **cartoon strips**, **photo novels**, **animation** (with animated characters), **stop motion** (with playmobil characters), **apps**, **3D CAD models**, and even **physical prototypes**.

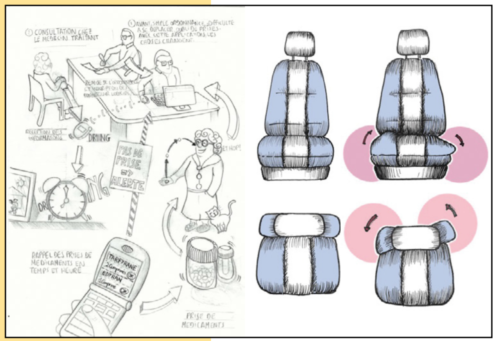
### Text

VIDEO LINK

*"So let's not use a stylus. We're going to use the best pointing device in the world. We're going to use a pointing device that we're all born with – born with ten of them. We're going to use our fingers. We're going to touch this with our fingers. And we have invented a new technology called multi-touch, which is phenomenal. It works like magic."*

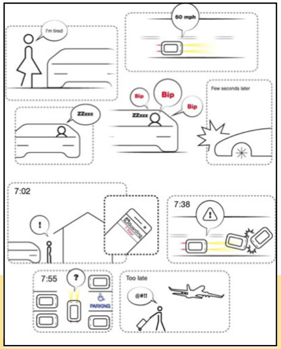
Steve Jobs speaking of the revolutionary user interface of the first iPhone at MacWorld 2007.

### Sketch

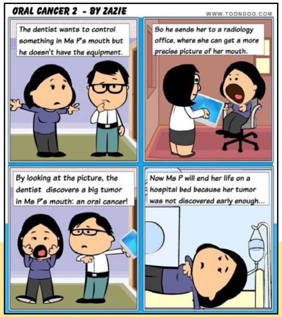


### Video with actors

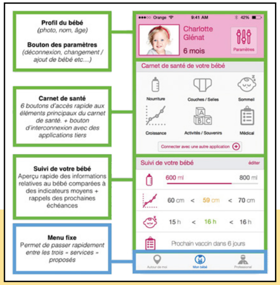
Storyboard




Cartoon strip




Apps



Rough

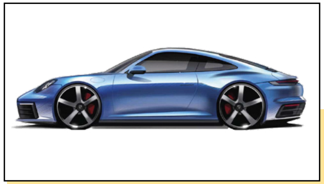


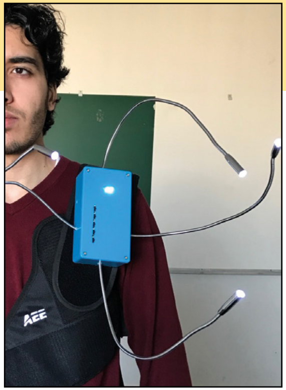
Photo novel

Stop motion


Animation

CAD model

Soft prototyping



Full prototyping

# 56 Books of knowledge

A series of **books of knowledge** (BoK) is produced at the end of the **knowledge design** sub-process. These are synthesized, informative and graphically illustrated reports on thematic sets of **deep knowledge** which have been selected for further investigation. The **books of knowledge** are presented to all project members in a final **knowledge design** review.

## What are books of knowledge useful for?

- They enable a project team to find a **common language** and to carry out collective work that can be shared with the other collaborators on the project, aligning people along a common representation of objects, concepts and even priorities.
- They are **intermediate design objects** (see (Jeantet, 1998) and (Bouchard et al, 2005)) which have a catalytic effect on collective **exploration**.
- They are very often reusable within the company for a certain period of time. This is why these BoKs are considered to be **deliverables of the RID project** in themselves.
- These objects **widen the fields of possibility** to search for new concepts, helping **avoid the fixation effect** (see **Thinking inside the box**).

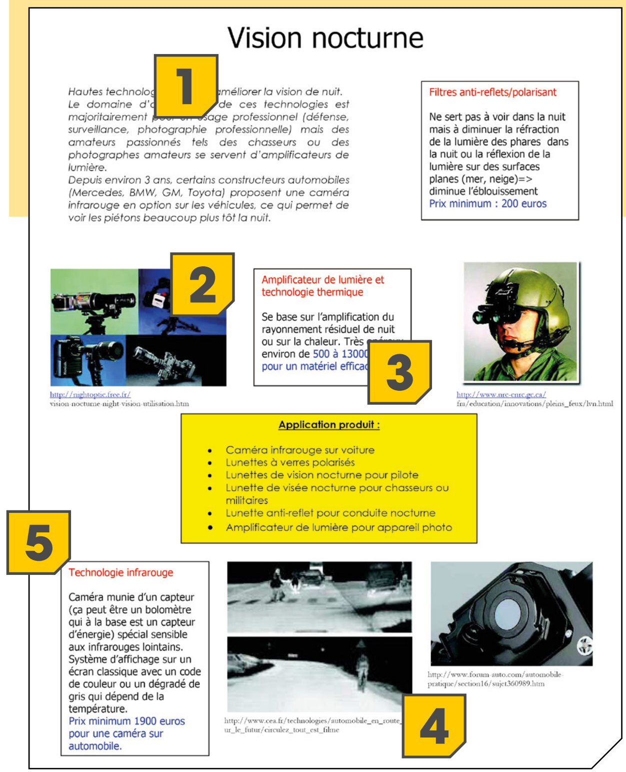
## What are books of knowledge typically composed of?

Each BoK (one to several pages) typically includes:

1. One **title** and the **definition** of this category of deep knowledge
2. Illustrative and captioned pictures
3. **Web links** to professional and commercial websites
4. **Bibliographical references**
5. Typical, trendy or amazing **products** with brief descriptions and **price estimations**
6. Links to **videos** for describing activities, names of **experts**, emerging **patents**…

Be imaginative!

## Example of a simple book of knowledge on night vision




**SOURCE**


Jeantet A., 1998. Les objets intermédiaires de la conception. Éléments pour une sociologie des processus de conception. *Sociologie du travail*, 3/98, 291-316.
Bouchard C., Camous R., Aoussat A., 2005. Nature and role of intermediate representation (IR) in the design process. *International Journal of Vehicle Design*, 38 (1), 1-25.

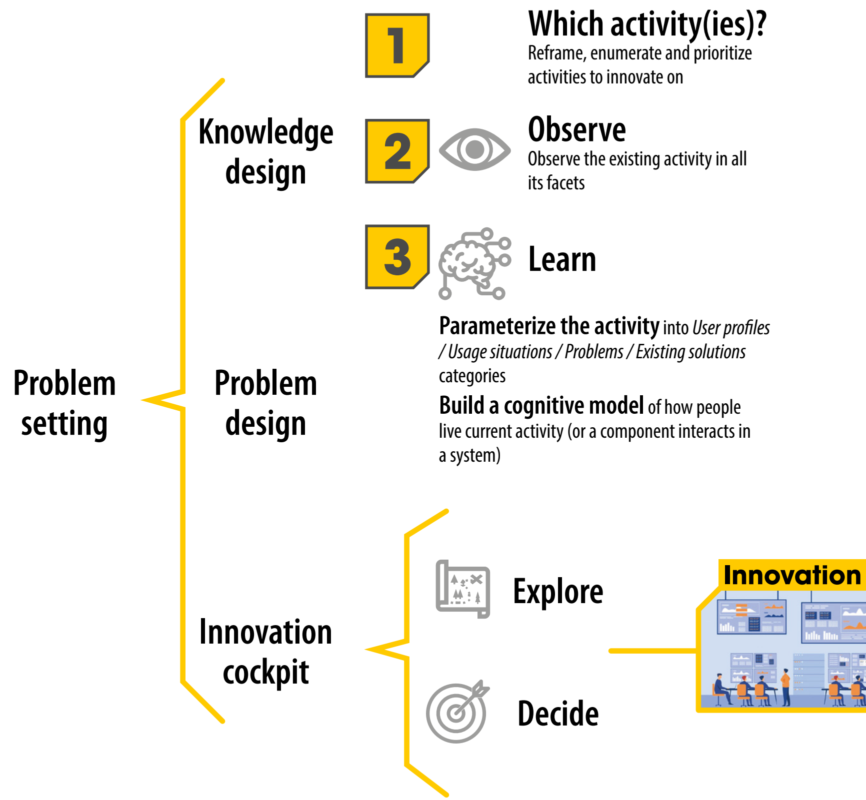
# Chapter 6

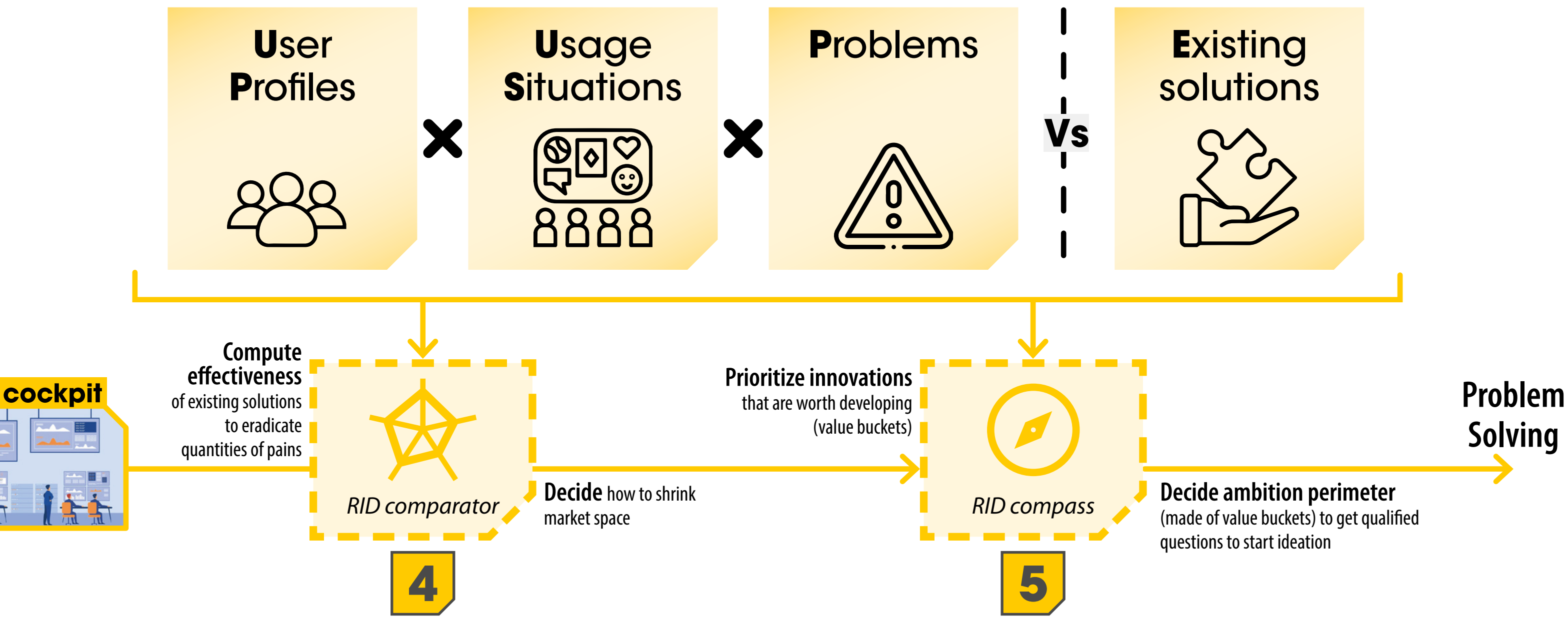
## Problem design

# 57 Zoom on RID problem setting

Once the choice of the **activity** to be explored has been determined, the "**problem setting**" part consists of:

- **Observing the existing activity** in all its facets (knowledge design / observe),
- **Parameterizing and building a cognitive model** of how people experience the current activity (or how a component interacts in a system), and
- Ending with "**explore and decide**" with the **innovation cockpit** in order to specify which innovations are worth developing.




User Profiles
Usage Situations
Problems
Vs
Existing solutions
cockpit
Compute effectiveness of existing solutions to eradicate quantities of pains
RID comparator
4
Decide how to shrink market space
Prioritize innovations that are worth developing (value buckets)
RID compass
5
Decide ambition perimeter (made of value buckets) to get qualified questions to start ideation
Problem Solving

# 58 RID study examples

Major elements of **5 real RID studies** are made available to the reader, with further development.

- **"Mobility in Grand Paris"** served as the storyboard of the RID serious game, and as a use case for a PhD thesis (Ma et al, 2023).
- **"AutoNOM project"** served to change the care in France of (elderly) patients suffering from orthopedic deformities due to neurological pathology.
- **"Falls of the elderly"** study is detailed in a report (Lecomte and Yannou, 2024).
- **"Cleaning solar panels"** led to a complete innovative PSO solution for cleaning solar farms in the desert. This example is also the most extensively detailed in this eBook and is reported in (Yannou, Lecomte and Cluzel, 2024).
- **"Book machine"** The "book machine" is an analysis of the needs of the book printing activity on campus and in the vicinity of the University of Paris-Saclay, and an aid to the choice of solutions, on behalf of the Lumen Learning Center, the university library revisited in the digital age.



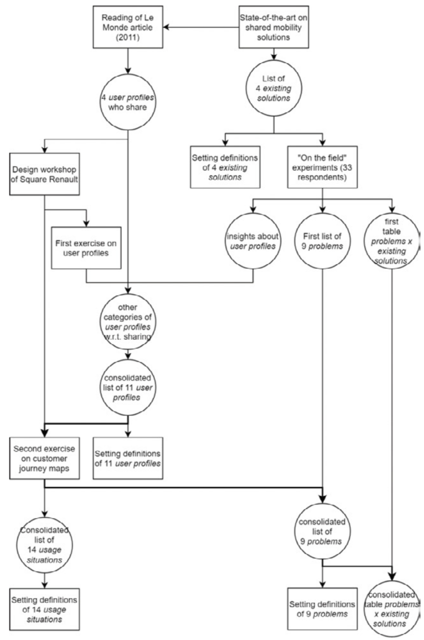


***SOURCE***

Ma Y., Vallet F., Yannou B., Cluzel F., 2023. Tools to help teachers and designers complete individual tasks when co-designing industrial engineering games - Application to the design of an innovation management game. *European Journal of Engineering Education*.
Lecomte, R., & Yannou, B. (2024). RID journal paper - RID study Falls of the elderly (Version V1). Zenodo.
Yannou, B., Lecomte, R., & Cluzel, F. (2024). RID journal paper – RID comparator and Cleaning solar panel study (Version V1). Zenodo.

# 59 Observing and parameterizing the activity

The process of **activity observation** (or investigation) and further **parameterization** (or categorization / segmentation) must be carefully and intelligently designed and documented to guarantee its reliability and traceability. Conventional tools of design ethnographic approaches may be used like persona method and user journey map.




A possible **investigation and categorization process**

The Mobility in Grand Paris example needed reading 12 scientific publications to justify the activity parameterization

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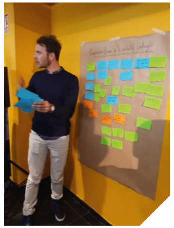
**Literature review** and **field exploration**

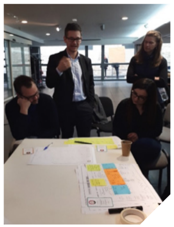
1 Observe activity

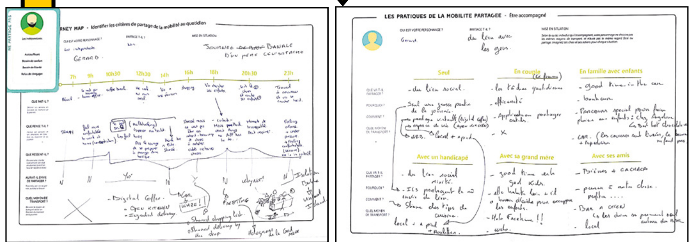
## "Mobility in Grand Paris" RID study example

Categorizing **user profiles** (persona characters)




Listing particular **problems** per user categories through user journey maps and particular **usage situations**





**Existing solutions** Vs **User Profiles** × **Usage Situations** × **Problems**

**2** Parameterize activity

# 60 Parameterization of the "Mobility in Grand Paris" RID study

**Activity:** Getting around in Grand Paris area
**Ideal goal:** Getting around in Grand Paris area quickly, safely, comfortably and cheaply with little or no environmental impact

| User Profiles | |
|---|---|
| **Full-time workers/ students** | Transportation workers |
| | Non-transportation workers |
| | Students |
| **Non-workers** | Children and young travelers |
| | Elderly travelers |
| | Disabled travelers |
| **Tourists and unfamiliar travelers** | Tourists |
| | Short-term visitors |
| | Passing travelers |

| Usage situations | |
|---|---|
| **Travel for work or education** | Commuting to work or education |
| | Commuting from work or education |
| | Business travel |
| **Travel for other purposes** | Leisure |
| | Shopping |
| | Accompanying others |
| **Special usage situations** | Emergency |
| | Travel in a poorly-served area |
| | Carry heavy weight |

| **Problems** | |
|---|---|
| **Personal problems** | Waste of time |
| | Lack of comfort |
| | Risk of increasing tiredness |
| **Social Problems** | Lack of safety |
| | Loss of public space |
| | High infrastructure maintenance costs |
| **Environmental Problems** | Poor air quality |
| | Noise |
| | $CO_2$ emissions |

| **Existing solutions** | |
|---|---|
| **Public transport** | Subway |
| | Bus |
| | Suburban express train |
| **Private transport** | Private car |
| | Private bicycles |
| | Walk |
| **Greener modes** | Electric car |
| | Self-service scooters |
| | Car-sharing |

The notable point of the parameterization here is that we managed to get 9 categories of each of the four classes of an activity (users, situations, problems, existing solutions), and each series of 9 categories is arranged into 3 **sub-categories** of 3. It enabled the narrative and game mechanics of the **RID serious game** to be structured, as well as to test *aggregate* and *expand* facilities of **RID comparator** and **RID compass** user interfaces of **HyB'RID company**.

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# 61 Parameterization of the "AutoNOM" RID study

**Activity:** The care in France of (elderly) patients suffering from orthopedic deformities due to neurological pathology
**Ideal goal:** Detect early enough any person developing ADH (orthopedic deformities due to neurological pathology), whether or not that person is demented and dependent, regardless of where they live (home, retirement home), in order to treat them effectively while respecting their physical and cognitive state

| User Profiles | Usage situations |
|---|---|
| **1.** 12 patient categories issued from combinations of modalities {medium, high} x {in, out} x {surgical, medical, prescription} for the three featuring variables of: (i) Patient autonomy, (ii) Life situation, (iii) Medical need<br>**2.** Care team | **1.** Detection<br>**2.** Diagnosis<br>**3.** Treatment<br>**4.** Follow-up |

| Problems | Existing solutions |
|---|---|
| 1. Long lead times | 1. Home Healthcare team |
| 2. Discomfort | 2. Mobile team |
| 3. Lack of safety | 3. Full hospital with detection by the retirement home or family |
| 4. Fears | **4. AutoNOM (innovative solution)** |
| 5. Lack of care | |

The difficulty here was to adopt the best logic for segmenting categories of user profiles. The most important beneficiaries of this activity are patients. The 3 discriminating variables for generating and sizing patient segments are: (i) Patient autonomy (regarding daily life: *high* autonomy for patients who can eat and dress themselves and *medium* if there is a restriction of participation in this daily life activities), (ii) Life situation (regarding the place of living of these patients: *inside* or *outside* retirement home), (iii) Medical need (after the diagnosis by the team: *surgical*, *medical* or rehabilitation *prescription*). The 13$^{th}$ user profile is the *care team*, whose voice must also be heard if the activity is to be ideally designed.

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# 62 Parameterization of the "Falls of the elderly" RID study

## User profiles

Each persona characterized by 3 parameters: health status, activity, isolation

1. Jocelyne Houdin (good, low, surrounded)
2. Emmanuel Chabert (good, high, surrounded)
3. Isabelle Leclère (good, low, isolated)
4. Serge Chaney (bad, low, isolated)
5. Marie-Christine Portie (good, high, isolated)

## Usage situations

1. Heavy fall, fainting
2. Heavy fall, stay awake
3. Heavy fall, broken member, fainting
4. Heavy fall, broken member, stay awake
5. Soft fall, stay awake
6. Soft fall, fainting

## Body states

1. Walking outside
2. Walking inside
3. Running
4. Walking at night
5. Carrying something
6. Going downstairs/upstairs
7. Bending down
8. Standing still
9. Getting up
10. Sitting down

*SOURCE*
Lecomte, R., & Yannou, B. (2024). RID journal paper - RID study Falls of the elderly (Version V1). Zenodo.

| Problems | Existing solutions |
|---|---|
| 1. Delay in detection and alert | 1. Passive wristband/pendant at home |
| 2. False detection and alert | 2. Active wristband/pendant at home |
| 3. No detection | 3. Active wristband/pendant mobile |
| 4. No transmission of the alert | 4. Active wristband/pendant Sigfox |
| 5. Notify the wrong person | 5. Cameras at home |
| 6. No or wrong location | 6. Sensors at home |
| 7. No access to the residence | |

**Activity:** Detection, alert and action following a fall for a French elderly person over 65 and living at home (not in an institution). It excludes the prevention and the mitigation of the fall.
**Ideal goal:** All falls are detected, triggering an immediate alert to people who can act immediately and usefully

We had two difficulties here: categorizing the user profiles and categorizing the usage situations. A scientific literature review (Lecomte and Yannou, 2024) revealed 17 variables influencing elderly falls. Then, they were aggregated into 3 macro-variables (health status, activity and isolation, which served to enumerate archetypical user segments. Usage situations correspond to accidental configurations like "heavy fall and fainting". In order to be able to weight the probability to be in a given situation for a given user, we needed to introduce a secondary segmentation of body states.

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# 63 Parameterization of the "Cleaning solar panels" RID study

**Activity:** Cleaning solar panels of solar farms
**Ideal goal:** A cleaning activity that ensures the restoration of maximum panel performance in all local conditions, regardless of the type of soiling and for all types of installations. The planned procedure is self-contained, easy to implement, inexpensive, fast and takes into account environmental impacts.

## User Profiles

Families of users:

1. Big plant (10 MWp) with structural glass
2. Big plant (10 MWp) with float glass
3. Small plant (500 kWp) with structural glass
4. Small plant (500 kWp) with float glass

## Usage situations

Five scenarios:

1. Trondheim (Norway): snow, cold, less sun
2. Paris (France): cement plant nearby, pigeons with bird droppings, installed on rooftop
3. Dubai (United Arab Emirates): sand/dust, low rainfall, medium humidity
4. Lagos (Nigeria): high humidity, very high rainfall in summer
5. Santiago (Chile): windy

| **Problems** | **Existing solutions** |
| --- | --- |
| General overview:<br>**1.** Slowness of cleaning<br>**2.** Lack of safety (for operator) and safety requirements<br>**3.** Environmental impact: water and material consumption<br>**4.** Damage to the panels<br>**5.** Long downtime to switch between lines<br>**6.** Substances remaining even after cleaning<br>**7.** CAPEX cleaning costs<br>**8.** OPEX cleaning costs | Families of solutions:<br>**1.** manual tools<br>**2.** mechanized tools<br>**3.** installed hydraulic systems<br>**4.** installed robotic systems<br>**5.** autonomous robots<br>**6.** coating systems<br>**7.** Venturi method<br>**8.** Ampere method |

Once again, the difficulty here was to imagine that the beneficiary users of the "solar panel cleaning" activity were the types of solar farms and that the usage situations were the typical conditions in which they evolved, i.e. their location characterizing the climatic conditions and the local workforce.

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***SOURCE***
Yannou, B., Lecomte, R., & Cluzel, F. (2024). RID journal paper – RID comparator and Cleaning solar panel study (Version V1). Zenodo.

# 64 Parameterization of the "Book machine" RID study

**Activity:** Operate printing work on the vicinity of the Paris-Saclay University Campus
**Ideal goal:** To operate printing work on the environment of the Paris-Saclay University Campus, accessible by any kind of public, with environmental impact lower than that of existing solutions, and without increasing price and delivery time

| User Profiles | Usage situations |
|---|---|
| 1. Students<br>2. Staff of Paris-Saclay University<br>3. Teachers<br>4. PhD candidates<br>5. Residents of Plateau de Saclay | 1. Print a leisure book<br>2. Print a doctoral thesis<br>3. Print your own books (self-publishing)<br>4. Print a course or a report<br>5. Print a scholar book |

| Problems | Existing solutions |
|---|---|
| 1. No stock | 1. Online bookshops (Amazon) |
| 2. Bad quality | 2. Local bookshops |
| 3. Printing cost | 3. Reprography department |
| 4. Printing delay | 4. Bookmachine |
| 5. Environmental impact | 5. School printers |
| 6. Lack of support | 6. Online self-publishing services |
| 7. Delivery time | |

There were no notable difficulties here in imagining either the typical users of a printing job in the vicinity of a university, typical printing situations or even general printing problems. The only difficulty was not to forget virtualized printing solutions such as online bookshops and online self-publishing services.

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# 65 The art of parameterizing an activity

**Parameterizing the activity** consists in segmenting the four classes of an activity into **appropriate categories or segments**.

- user profiles
- usage situations
- problems
- existing solutions

In respecting the 3 following recommendations, the RID algorithms (in RID comparator and RID compass) will deliver satisfactory results, while allowing to aggregate and, conversely, expand macro-categories, so as to zoom in or zoom out opportunistically for exploring the cognitive model.

**1** A good category must be defined by a set of properties and its definition carefully defined and written

**2** It is recommended that the set of categories of one activity class forms a mathematical partition, i.e:

- all categories be mutually exclusive,
- their union totally covers the activity class.

**3** It is recommended that the categories be classified in a hierarchy of macro-categories

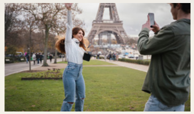
## Mobility in Grand Paris" RID study

3

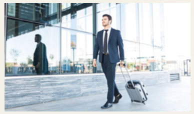
**Tourists and unfamiliar travelers**

2

**Tourists**



**Short-term visitors**



**Passing travelers**

1

These people suffer lost-in-translation problem.
They have high mobility needs, but limited spatial and linguistic knowledge.

- Tourists' destinations are mainly scenic spots, they usually use public transportation.
- Short-term visitors have business travel in a city for a few days. They may use public or private transportation.
- Passing travelers visit a city to participate in a particular event (e.g., concerts and exhibitions) and leave immediately after the event. They pay more attention to the punctuality and practicality of transportation.

| **User Profiles** | |
|---|---|
| **Full-time workers/students** | Transportation workers |
| | Non-transportation workers |
| | Students |
| **Non-workers** | Children and young travelers |
| | Elderly travelers |
| | Disabled travelers |
| **Tourists and unfamiliar travelers** | Tourists |
| | Short-term visitors |
| | Passing travelers |

| **Usage situations** | |
|---|---|
| **Travel for work or education** | Commuting to work or education |
| | Commuting from work or education |
| | Business travel |
| **Travel for other purposes** | Leisure |
| | Shopping |
| | Accompanying others |
| **Special usage situations** | Emergency |
| | Travel in a poorly-served area |
| | Carry heavy weight |

| **Problems** | |
|---|---|
| **Personal problems** | Waste of time |
| | Lack of comfort |
| | Risk of increasing the tiredness |
| **Social Problems** | Lack of safety |
| | Loss of public space |
| | High infrastructure maintenance costs |
| **Environmental Problems** | Bad air quality |
| | Noise |
| | $CO_2$ emissions |

| **Existing solutions** | |
|---|---|
| **Public transport** | Subway |
| | Bus |
| | Suburban express train |
| **Private transport** | Private car |
| | Private bicycles |
| | Walk |
| **Greener modes** | Electric car |
| | Self-service scooters |
| | Car-sharing |

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# 66 User profiles

The **stakeholders** concerned by the activity are investigated in the knowledge design stage and segmented in **user profiles**. Different user profiles can be taken into account depending on whether they practice different **sub-activities** or whether their contribution to the activity is different.

A **user profile** is a category clearly qualified by **common habits and similar forms of activity**: sharing the same sets of usage situations, similarly perceiving satisfactions and problems, and using similar preferred existing solutions.

**Statistical data** should be collected to quantify their number and their habits on activities, especially their adherence to **usage situations**, **problems** and **existing solutions**.

## Don't use persona characters! User profiles are better

Like for usage scenarios, do not confuse **personas** and **user profiles**. A persona (Persona Method proposed in 1999 by Alan Cooper) is an imaginary archetypal character with an invented universe (precise point-based or crisp description) whereas a **user profile** is a category or user segment (set-based or class description) defined by ranges of admissible properties.

### Example of persona:

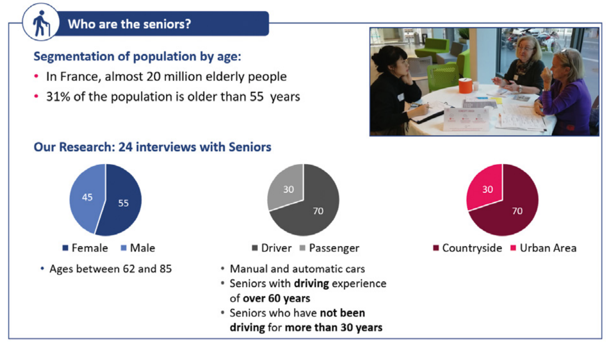
Paulette, 65 years old. She lives on her own in a beautiful house. She doesn't have major health issues but her family circle helps her to do shopping, housework…

## Representations of user profiles

**1** Raw statistical data on users are a primary result which needs to be completed by segmentations of 1. or 2. types

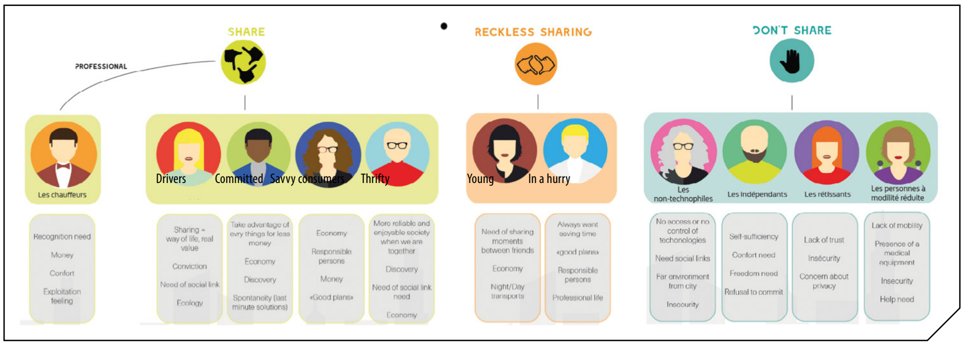
**2** User profiles defined by: age, gender, socio-professional category, income, habit, empathy, feelings, emotions, etc…

**3** User profiles defined by sub-activities.




**1** **Statistical data for seniors using cars**

**2** **User profiles for mobility**



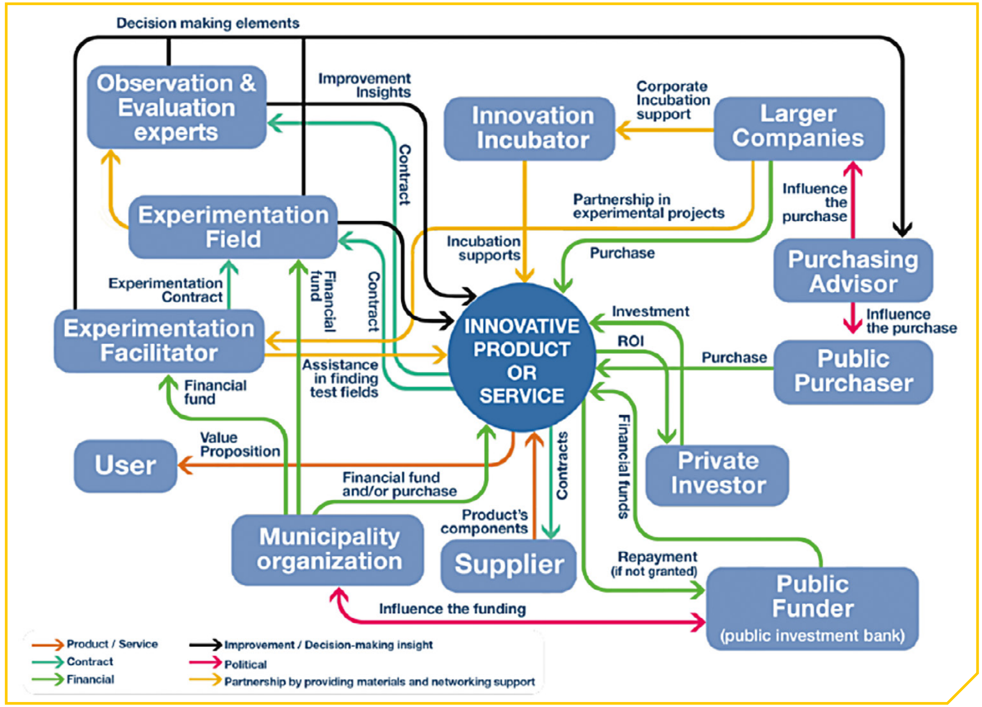

**Subactivities related to activity "lighting for DIY activity"**

**3**

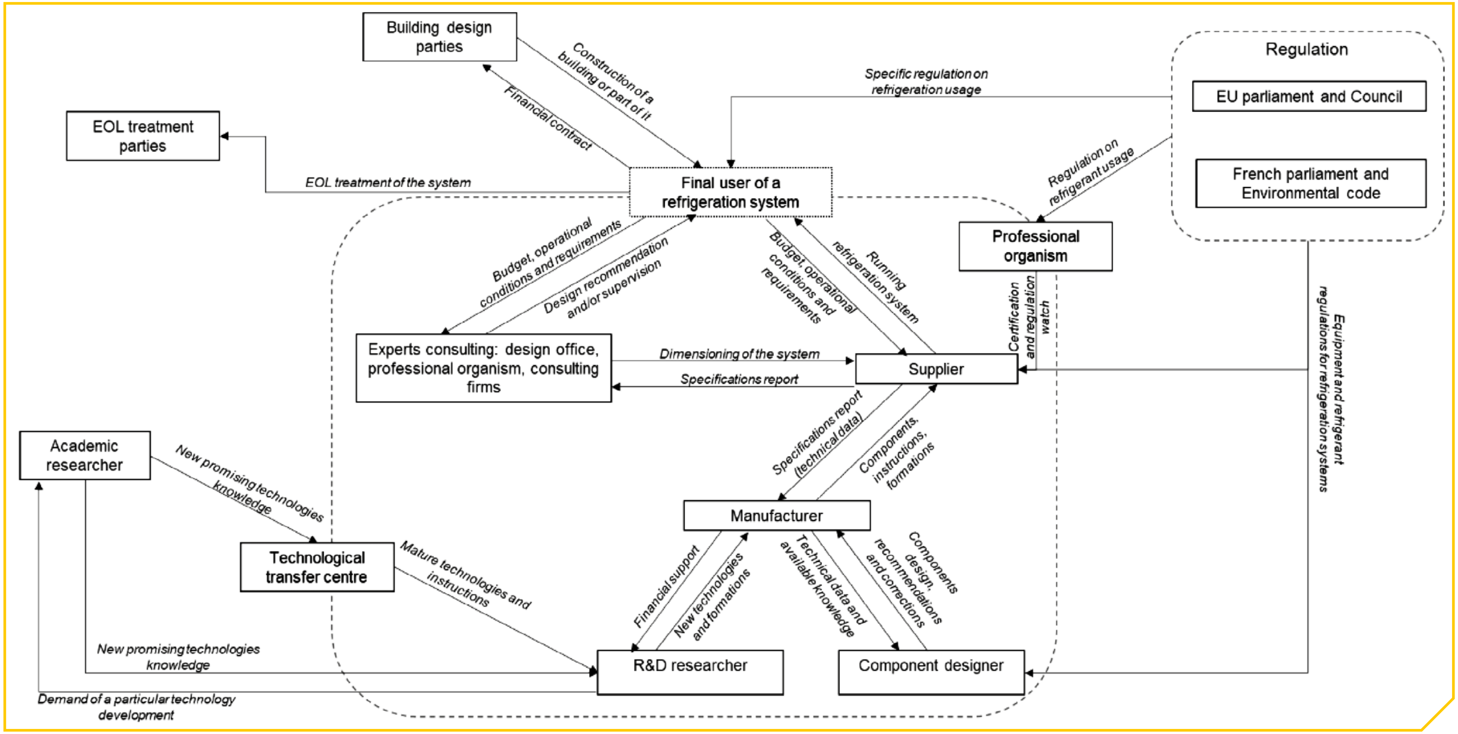
**SOURCE**
Cooper, A. (1999). *The inmates are running the asylum: Why Hi-tech Products Drive Us Crazy and How to Restore the Sanity.* Indinapolis, USA: Macmillan Publishing Co, ISBN: 978-0672316494.

# 67 Interaction graphs between user profiles

The elicitation of user profiles may be facilitated by drawing **interaction graphs** semantically relating activity stakeholders. They are called **semantic graphs** or **Stakeholder Value Networks** (SVN). Such graphs highlight the specific contribution and collaborations between user profiles in activity accomplishment.




**The Parisian urban innovation Stakeholder Value Network (SVN) (Bekhradi 2018)**




**Definition of the 12 categories of user profiles and interaction diagram between them, for the activity of "designing, using, maintaining and recycling of a supermarket refrigeration system" (Salehy et al. 2021)**

*SOURCE*

Bekhradi A., 2018. Planning technology maturation by exploration of useful problems in markets: The case of innovative startups. PhD thesis. Université Paris-Saclay.

Salehy Y., Yannou B., Leroy Y., Cluzel F., Fournaison L., Hoang H.-M., Lecomte R., Delahaye A. Diagnosis of development opportunities for the socio-technical refrigeration system using the Radical Innovation Design (RID) methodology, in *23rd International Conference on Engineering Design (ICED)*: Gothenburg, Sweden (2021)

# 68 Usage scenario

A **usage scenario** is a **screenplay, script** or **story** that narrates the global context of an activity. The general context is made up of activity components: the activity definition (physical and social surroundings, temporal perspective, tasks definition), the object (motive, goal), the subject (user, customer), the activity outcomes (KPIs), the rules, the community, usual solutions (tools) and organization (division of labor). See also (**activity breakdown**).

A usage scenario is used in RID as an initial description of an existing activity or of a future activity to be designed (the latter being a **dreamt usage scenario**).

A usage scenario is segmented into typical **usage situations**.

## Don't use the Persona method!

Many people use the Persona Method (proposed in 1999 by Alan Cooper) to express a **usage scenario**. Although it is undoubtedly a good tool to use to **ideate** from persona stories, it is heavily character-centered. In RID, it is therefore questionable whether this point-based description is representative of all typical situations related to the targeted activity. Following the **set-based thinking** principle, it is preferable to define a usage scenario as a set of situations, describing the contexts precisely, providing **quantifications** when possible and **segmenting** them into typical **usage situations**.

## A RID compatible usage scenario

*The elderly are often bored in retirement homes, spending at most 2 hours a week collectively in discussion with a psychologist. Nurses do not have any more time in their schedules to discuss or play with them.*

*Their daily activities are inadequate. Nobody tries to motivate them to play board games, few have access to new crosswords… Previously, they liked to walk in the open-air, practice sport or gardening, but most of them cannot garden anymore due to their rheumatism and joint limitations.*

***SOURCE***

Yannou B., Chen W., Wang J., Hoyle C., Drayer M., Rianantsoa N., Alizon F., Mathieu J.-P., (2009) 'Usage Coverage Model For Choice Modeling: Principles', *Proceedings of IDETC/DAC: Design Automation Conference, San Diego, CA, August 30 - September 02*

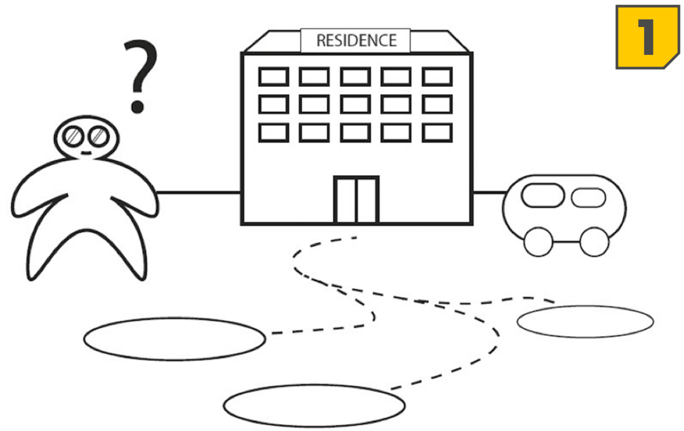
# 69 Usage situation

While a **usage scenario** is linked to an activity in **activity theory**, a **usage situation** is linked to an episode, a particular scene, a series of actions, one of the processes or a task, i.e. a portion of the activity.

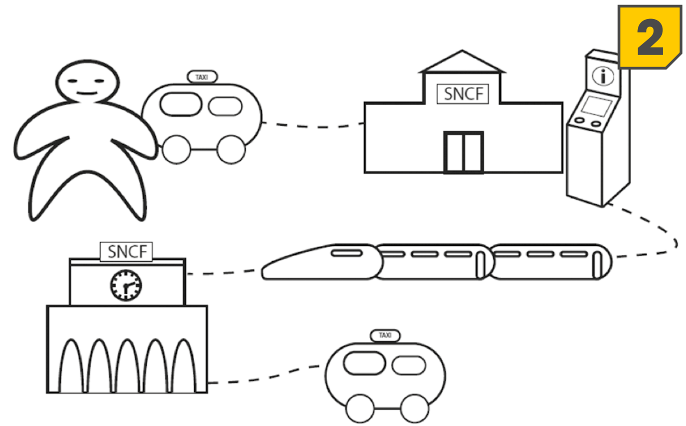
An **activity** can be decomposed into a series of **usage situations**.

## Just follow typical user profiles during their activity

Uncovering **usage situations** may be performed by following typical user profiles during their activity. For activity "*mobility of elderly people*", coming up with a set of typical **usage situations** are done by considering different user profiles after their living conditions, autonomy capacities and financial resources.

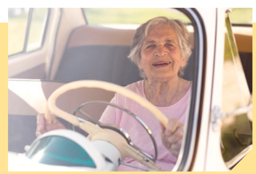
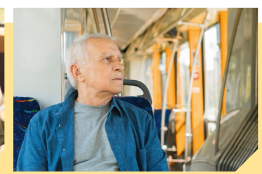



Mobility **usage situations** of an active elderly person living in an assisted residence in a peri-urban area




Mobility **usage situations** of an elderly motorist forced to abandon his/her car and therefore switch to alternative modes




***SOURCE***

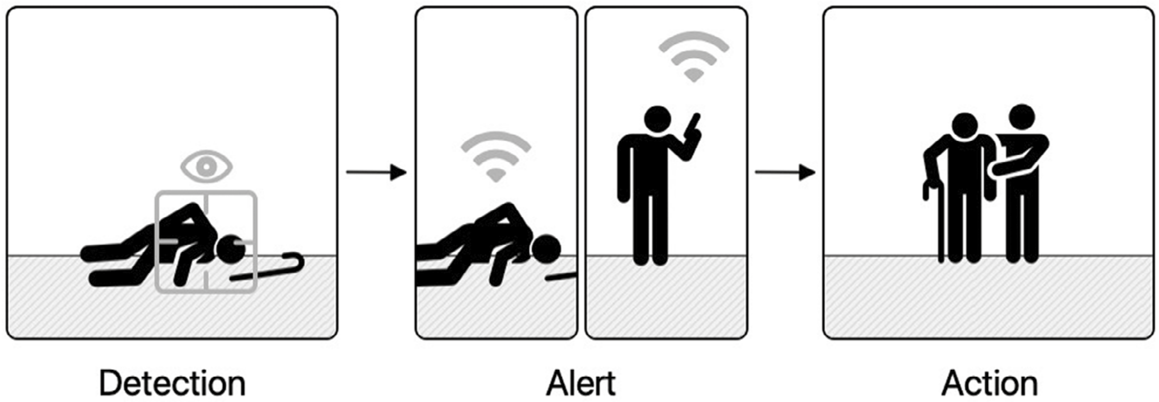
Bekhradi A., Yannou B., Cluzel F., Vallette T., 2017. Categorizing users pains, usage situations and existing solutions in front end of innovation: The case of smart lighting project, In 21st *International Conference on Engineering Design (ICED)*, August 21-25, Vancouver, Canada.

# 70 Process representation linking usage situations

The **usage situations** are stated (short title, description with contexts, conditions), related to the **user profiles** and quantified by their **duration** or **frequency of occurrence**.

We recommend to articulating the set of usage situation categories in a comprehensible **process representation of the generic activity** (a kind of state-transition graph). Indeed, it is a guarantee that this set of usage situation categories be a mathematical partition.

**Example:**
**"Falls of the elderly"**
**RID study**




*SOURCE*
Lecomte, R., & Yannou, B. (2024). RID journal paper - RID study Falls of the elderly (Version V1). Zenodo.

## Example: "Accesseat" RID study

Problem Design

### Identification of usage situations

Only driver affected

**Entering the vehicle**

- Sitting down
- Putting on the seat belt

**During the journey**

- Wearing the seatbelt
- Adjusting of the center console
- Adjusting at steering wheel level

**Leaving the vehicle**

- Removing the seat belt
- Getting out of the vehicle

**Installation inside the vehicle**

- Deposition of personal things
- Adjusting the seat
- Adjusting the mirrors
- Adjusting the steering wheel

**Extreme situations occurring during a car ride**

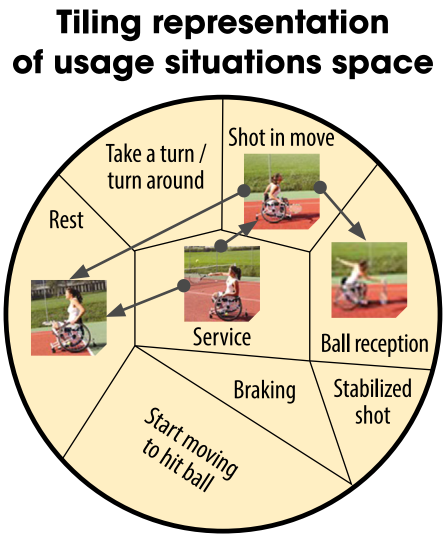
- Reacting in critical situations
- Driving on a long journey
- Driving on road in poor conditions
- Driving on a fast road
- Driving against the light
- Reacting at an intersections
- Maneuver to park within the city

# 71 Covered usage situations

**Usage situations** may be graphically displayed in a tiling style. This graphical representation serves to **visualize situations where existing solutions may be useful**. Designers can discuss and stick post-its on the appropriate tiled situations, providing explanations which are recorded (traced).

This representation of **covered usage situations** may greatly facilitate the completion of the **UsEs matrix** "*Level of usage facilitation for existing solutions*" to complete the **cognitive model** of activity (see further), and then compute **effectiveness indicators** and **value buckets**.

## Example: "Handitennis" RID study

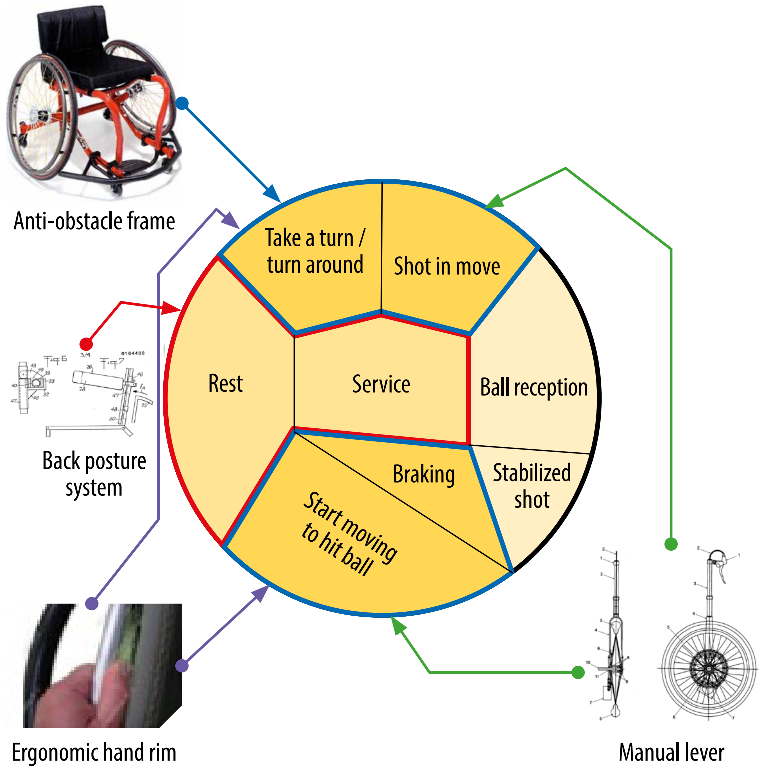



Proximity of two usage situations can mean two things:

**1.** a high probability of succession, linking the two activities in time

**2.** similarity of user categories and usage contexts

## Covered usage situations space




## Facilitating the building of the cognitive model while ensuring traceability

### To what extent does this solution facilitate this usage situation?

- The *manual lever* is very efficient during the *start moving* situation and moderately so during the *shot in move situation*
- The *back posture* system is efficient during the *serve* situation

| | |
|---|---|
| 0 | Null |
| 1 | Weak |
| 2 | Moderate |
| 3 | Average |
| 4 | Important |
| 5 | Very important |

| ***further named UsEs matrix*** | Back posture system | Anti-obstacle frame | Manual lever | Ergonomic hand rim |
|---|---|---|---|---|
| Serve | 4 | 1 | 0 | 0 |
| Shot in move | 1 | 5 | 3 | 3 |
| Ball reception | 1 | 3 | 0 | 2 |
| Start moving | 1 | 2 | 5 | 5 |


***SOURCE***

Yannou B., Cluzel F., Farel R., 2016. Capturing the relevant problems leading to pain and usage driven innovations: the DSM Value Bucket algorithm. *Concurrent Engineering - Research And Applications (CERA), 1-16.*

# 72 Problems

A **problem** is not only an issue, a concern, an irritant, a dissatisfaction, a lack, a trouble, a dysfunction, it is also an insufficient amount of an expected performance. A problem encompasses at the same time **pains and gains**. **Problems** are differently experienced by users during specific usage situation. They can be consciously expressed, but they can also be internalized as "the way things work" and have to be uncovered by designers during knowledge design investigations.

Sketching **causal graphs** reveals the various interacting **causes** of problems and their **consequences**.

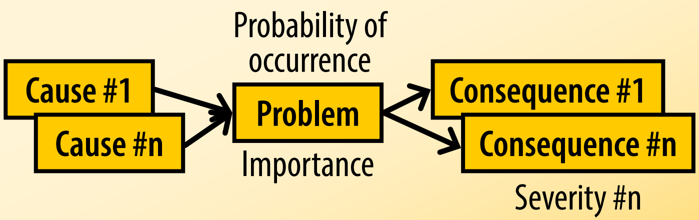
In a RID project, problems are segmented and used to express **value buckets**.

**In RID, the words "need" and "requirement" do not exist to ensure greater objectivity.**

RID focuses on proved unmet **problems** of importance rather than on supposedly expressed **needs** or preexisting **requirements**. Contrary to most design methodologies, the words "needs" and "requirements" are thus banished from RID as they appear to be illusory; they are considered as designer projections and fantasies. RID chooses to objectively **qualify and quantify** problems and to describe their importance, as well as their presence, in **usage situations**.

## A model borrowed from FMEA

**Problems** are **failure modes** with **consequences** of different **severities**. The averaged severity and the **probability of occurrence** of a failure mode determine its importance. Therefore, they must be investigated to assess the potential of value creation for solving a given problem. **Causes** of failure modes must also be investigated as they are major innovation seeds during **ideation stages** for removing or lowering failure modes. This is a simplified model borrowed from the ***Failure Modes and Effects Analysis*** **(FMEA)** method.




## Example: "Accesseat" RID study

| Problems faced by the elderly during a car journey | |
|---|---|
| **Tiredness** | "While adults are told to take breaks every two hours, **for the elderly it should be more frequently**." |
| **Visibility** | "I **see less and less** so at night I don't drive anymore" |
| **Physical pain** | "The worst thing with going by car is that my **bottom starts to hurt** after a while, then my **hip** and also my **leg**." |
| **Movement restriction** | "I **cannot easily reach** everything around me. The functions are **too small, too hard, too far**.." |
| **Lack of attention** | "With age, the elderly are **less responsive, less attentive**, so reaction speed is slower." |
| **Discomfort** | "The comfortable positions for the elderly are different from ours because **their muscles are less efficient**." |
| **Anxiety** | "I cry because it is **too stressful**, and I feel terrible and alone." |
| **Memory** | "Sometimes I **forget** some things." |

***SOURCE***
Yannou B., Lamé G., Cluzel F., 2018. Adapting the FBS model of designing for usage-driven innovation processes, In IDETC/CIE 2018: *International Design Engineering Technical Conferences / CIE: Computers and Information in Engineering*, August 26-29, Quebec City, Quebec, Canada.

# 73 Causal graphs

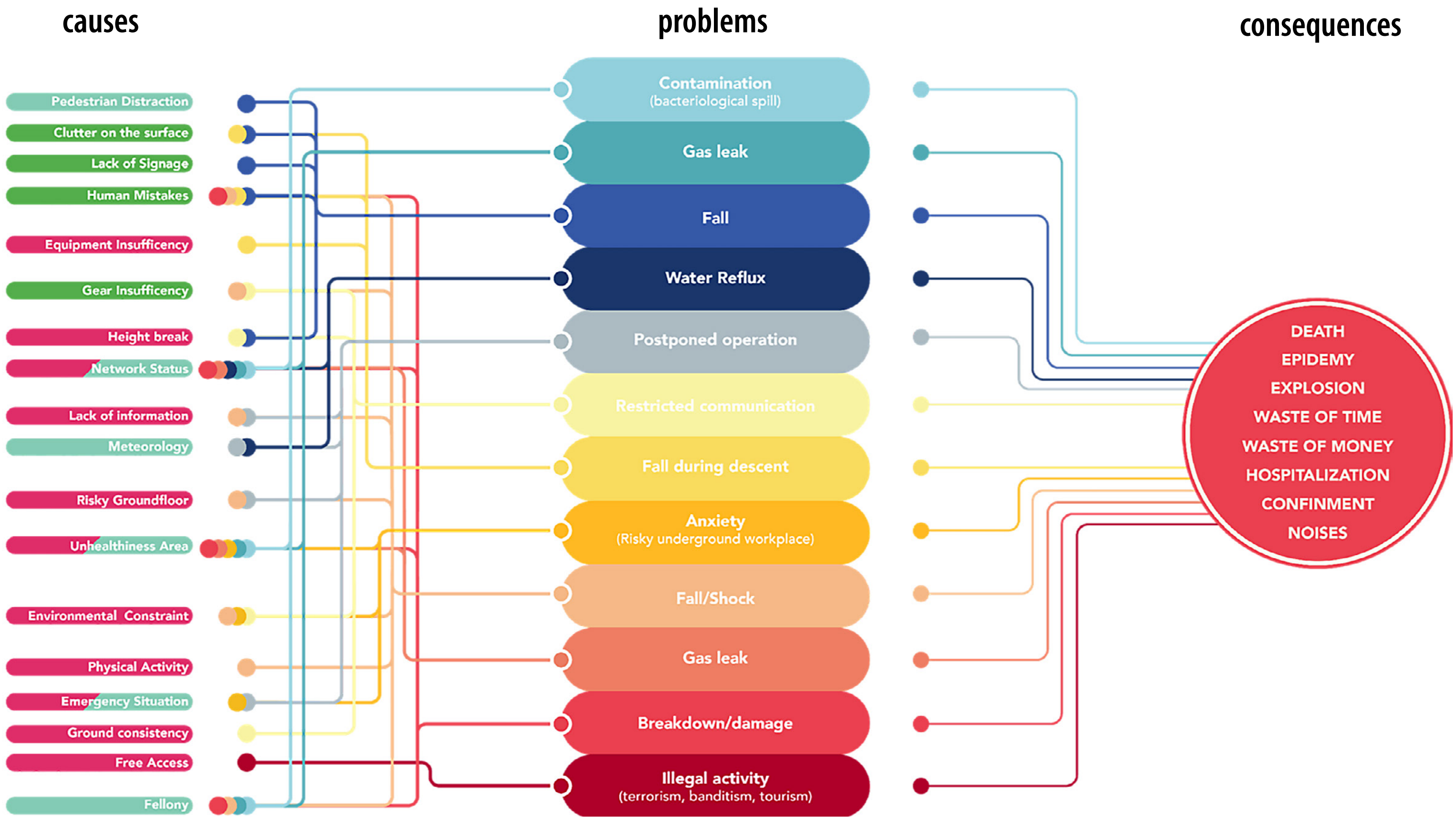
**Causal graphs** link problems, causes and consequences. Sketching a **causal (or causality) graph** leads to graphically and interactively uncovering the various problems experienced by users during an activity, as well as their causes and consequences. **Causality graphs** are most often organized into three areas: causes linked to problems, which are themselves linked to consequences. Several layers can exist for each of the three categories, revealing complex interactions. Causal paths may even loop, like in system dynamics models.

### What is the purpose of a causal graph?

**Causal graphs** have several uses:

- listing all the problems, resulting in a holistic representation to better understand underlying phenomena,
- causes serve to start ideation from a corresponding value bucket,
- consequences allow you to evaluate the relative severities of problems,
- causality graphs enable the visualization of how existing solutions cover (alleviate) problems,
- they are the support of metrics and quantification.

## Example of a one-layer graph: "Underground network operations" RID study



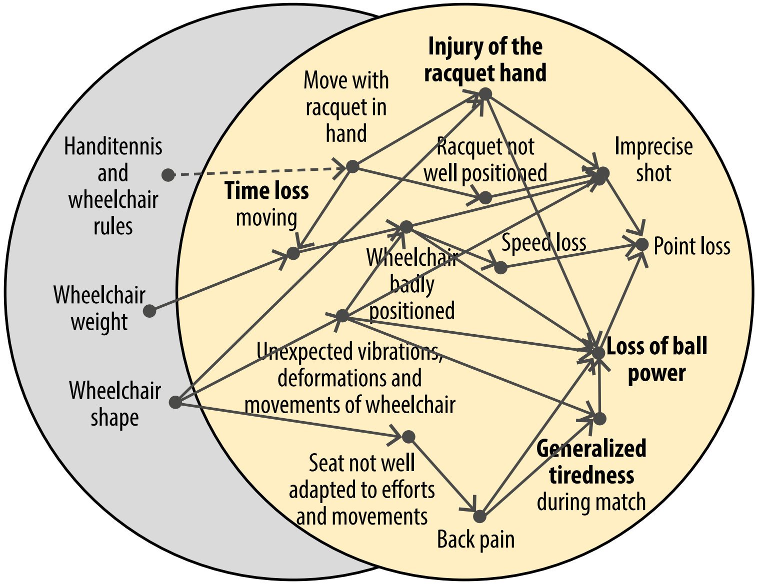

**SOURCE**
Schaffernicht M., 2007. Causality and diagrams for system dynamics, *In 50th International Conference of the System Dynamics Society,* Boston.

# 74 Building a causal graph

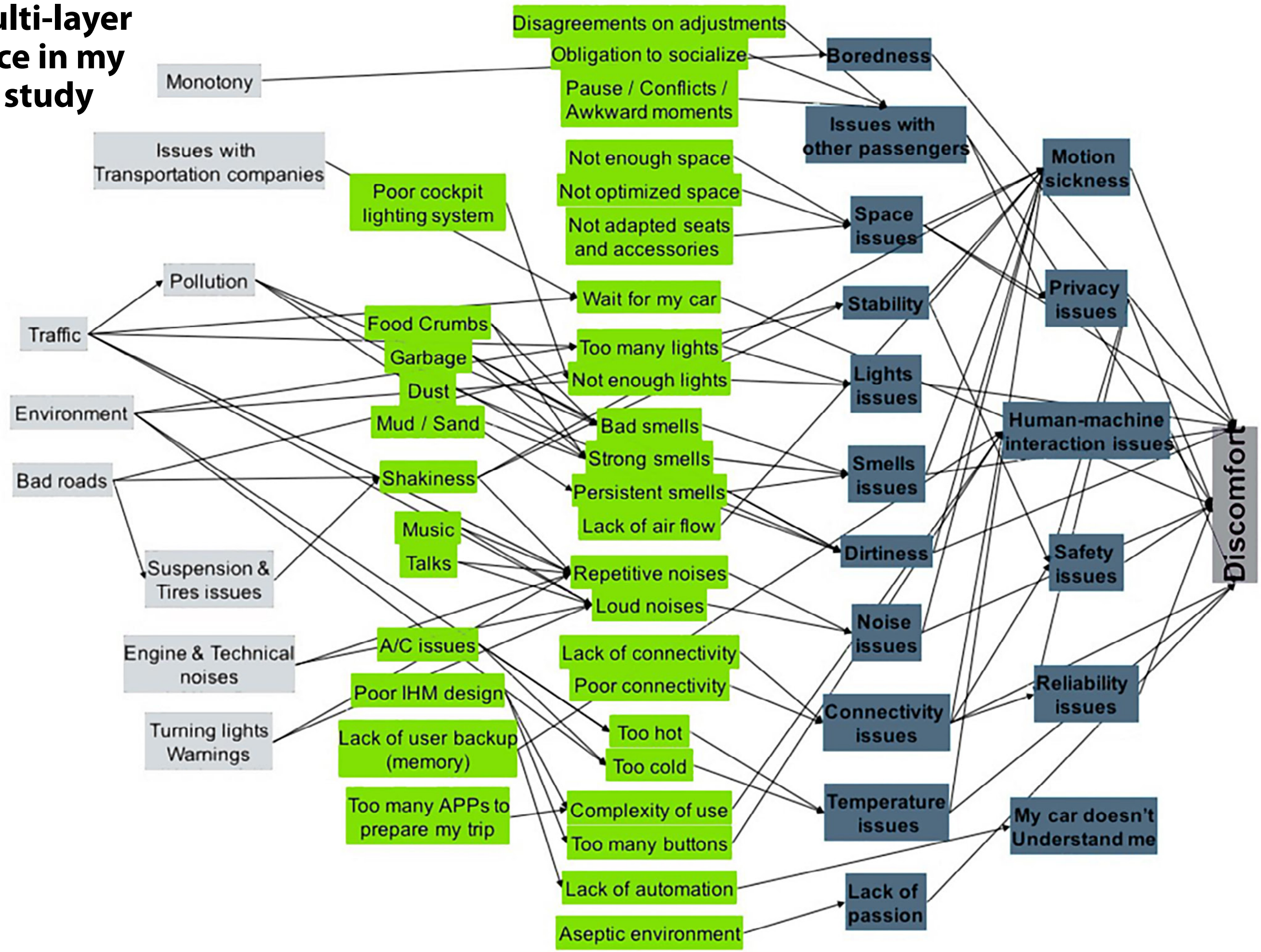
Process for **building a causal graph:**

1. Start from the **ideal goal** to **state the problems** to be solved in detail (see "Why? Because… there are problems" during **reframing**)
2. Start from problems and go back to the causes
3. Redeploy causes to problems and consequences to identify missing links
4. Assign only one measurable variable to each problem
5. Define the measurement framework, i.e. experimental conditions, for measuring this problem in the usage situations considered
6. Define "real performances" and "ideal performances" for each problem (see **The scale of activity performances**)
7. **Qualify and quantify** causal influences with a sign and an order of magnitude.

**Example of a multi-layer graph: "Handitennis" RID study**



## Example of a multi-layer graph: "Ambiance in my car cockpit" RID study



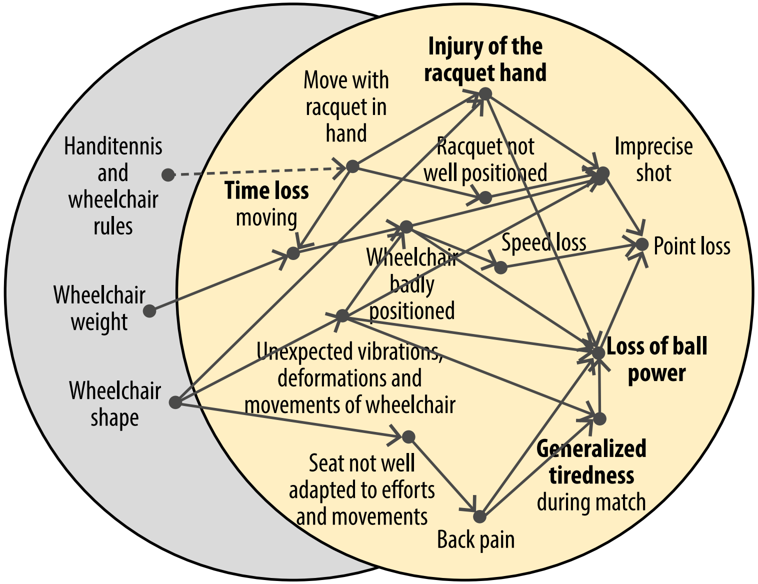
# 75 Covered problems

**Problems** can be graphically displayed in a causal (or causality) graph, along with their causes and consequences. This graphical representation may allow the visualization of causal pathways where existing solutions may be effective. Areas of influence can be circled, providing explanations which are recorded (traced).

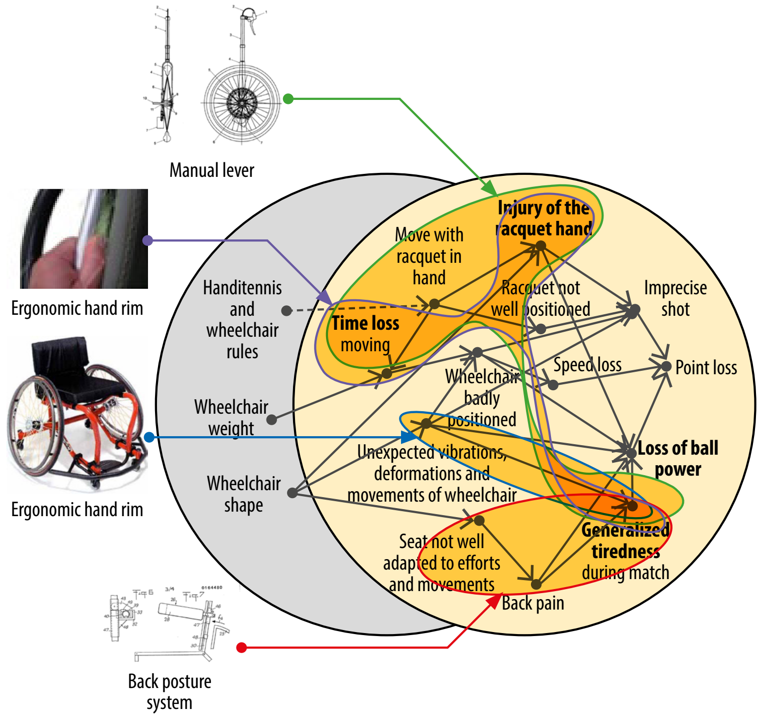
Finally, this **covered problems** representation may greatly facilitate the filling of **EsP matrix** "*Level of problem solving for existing solutions*" to complete the **cognitive model** of activity (see further), and then compute **effectiveness indicators** and **value buckets**.

## Example: "Handitennis" RID study

### Causal graph representation



## Covered problems representation




## Facilitating the building of the cognitive model while ensuring traceability

### To what extent does this solution eliminate

- The *ergonomic hand rim* is very important for avoiding racket *hand injury*
- Both the *back posture system* and the manual lever are good for relieving *generalized* tiredness
- The *ergonomic hand rim* also partly reduces *time loss*

| | |
|---|---|
| 0 | Null |
| 1 | Weak |
| 2 | Moderate |
| 3 | Average |
| 4 | Important |
| 5 | Very important |

| *further named EsP matrix* | Back posture system | Anti-obstacle frame | Manual lever | Ergonomic hand rim |
|---|---|---|---|---|
| Time loss | 1 | 2 | 4 | 0 |
| Power loss | 2 | 1 | 3 | 0 |
| Tiredness | 4 | 2 | 4 | 3 |
| Hand injury | 3 | 4 | 3 | 5 |

***SOURCE***

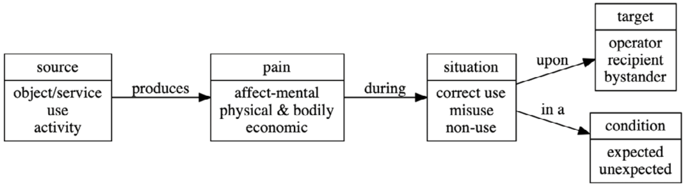
Yannou B., Cluzel F., Farel R., 2016. Capturing the relevant problems leading to pain and usage driven innovations: the DSM Value Bucket algorithm. *Concurrent Engineering - Research And Applications* (CERA), 1-16.

# 76 Naming problems

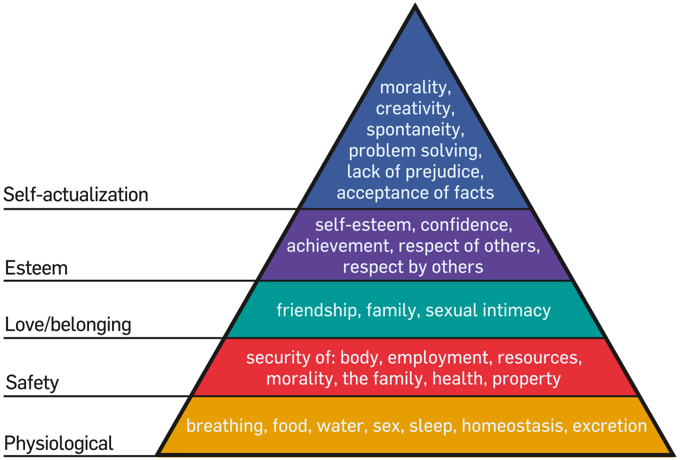
What constitutes a **problem** in RID? In RID, a **problem** can be a "**pain**", but also a lack of "**gain**", i.e. something pleasant that is not present enough in current situations. There is therefore no need to differentiate them as is done in [1]. But how do you **name problems**? You can consider them as:

- **failure modes**,
- fundamental expectations, as in **Maslow's hierarchy of needs**,
- emotions, as in **Plutchik's chart of emotions**,
- a **combination**.

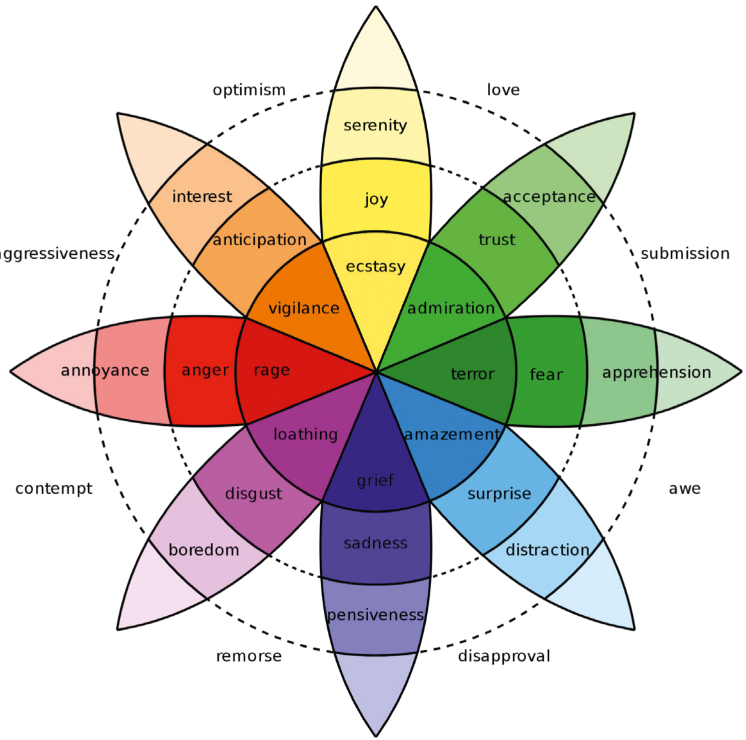
**Ontology of pain model [2]**




**Maslow's hierarchy of needs**

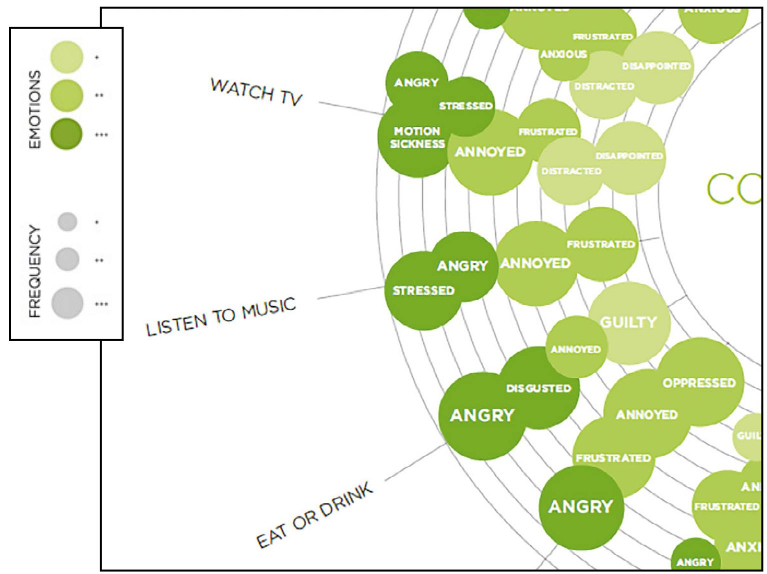


## Plutchik's chart of emotions




## Original use of emotions map with RID

In this example concerning activities in autonomous cars, problems are expressed as negative emotions for each usage situation. Emotions are characterized by their intensity and frequency.




**SOURCE**


[1] Osterwalder A., Pigneur Y., Bernarda G., Smith A., Papadakos P., 2014. *Value Proposition Design*, Hoboken, New Jersey: John Wiley & Sons, Inc, ISBN: 978-1-1189-6805-5.
[2] Dong A., Yannou B., 2016. A model of product-induced pain, In *Norddesign*, August 10-12, Trondheim, Norway

# 77 Existing solutions

During **knowledge design, existing Product-Service-Organization solutions**, which may be linked to a given activity, are inventoried and documented.

They are subsequently classified into a small number of categories (typically 3 to 12) which are captioned and illustrated.

**Existing solutions** range in their effectiveness in alleviating identified **problems**, and therefore in their relevance and effectiveness during **usage situations**. This is why the adequacy of existing solutions is represented graphically using **covered problems** and **covered usage situations**, then transformed into matrices that are useful for computing **value buckets**.

## Method for inventorying elementary existing solutions

- Brainstorm starting from a **problem** or a **usage situation**
- Patent-based research
- Reading market surveys

## Method for segmenting

- Define a segment of **existing solutions** based on common functional attributes: How do they work? In which **usage situations**? To solve which **problem(s)**?

## Example: "Accesseat" RID study

(segmentation by problems)

### Existing solutions for aiding elderly car journeys

#### For Visibility

- Dehumidifiers
- Additional mirrors
- Additional sun visors

#### For Concentration

- Steering wheel control
- Voice control
- Driving assistance
- Navigation system

#### For Physical Comfort

- Seat adapted to bending
- Heated seat cover
- Suitable seat for back pains

#### For Security

- Handybar
- Swivel cushion
- User manual

## Example: "Plasterer's activity" RID study

(segmentation by usage situations)

Plate maker's tables

Plate transporters

Plate lifters and positioners

**SOURCE**

Bekhradi A., Yannou B., Cluzel F., Vallette T., 2017. Categorizing users pains, usage situations and existing solutions in front end of innovation: The case of smart lighting project, In *21st International Conference on Engineering Design (ICED)*, August 21-25, Vancouver, Canada.

# 78 Cognitive model

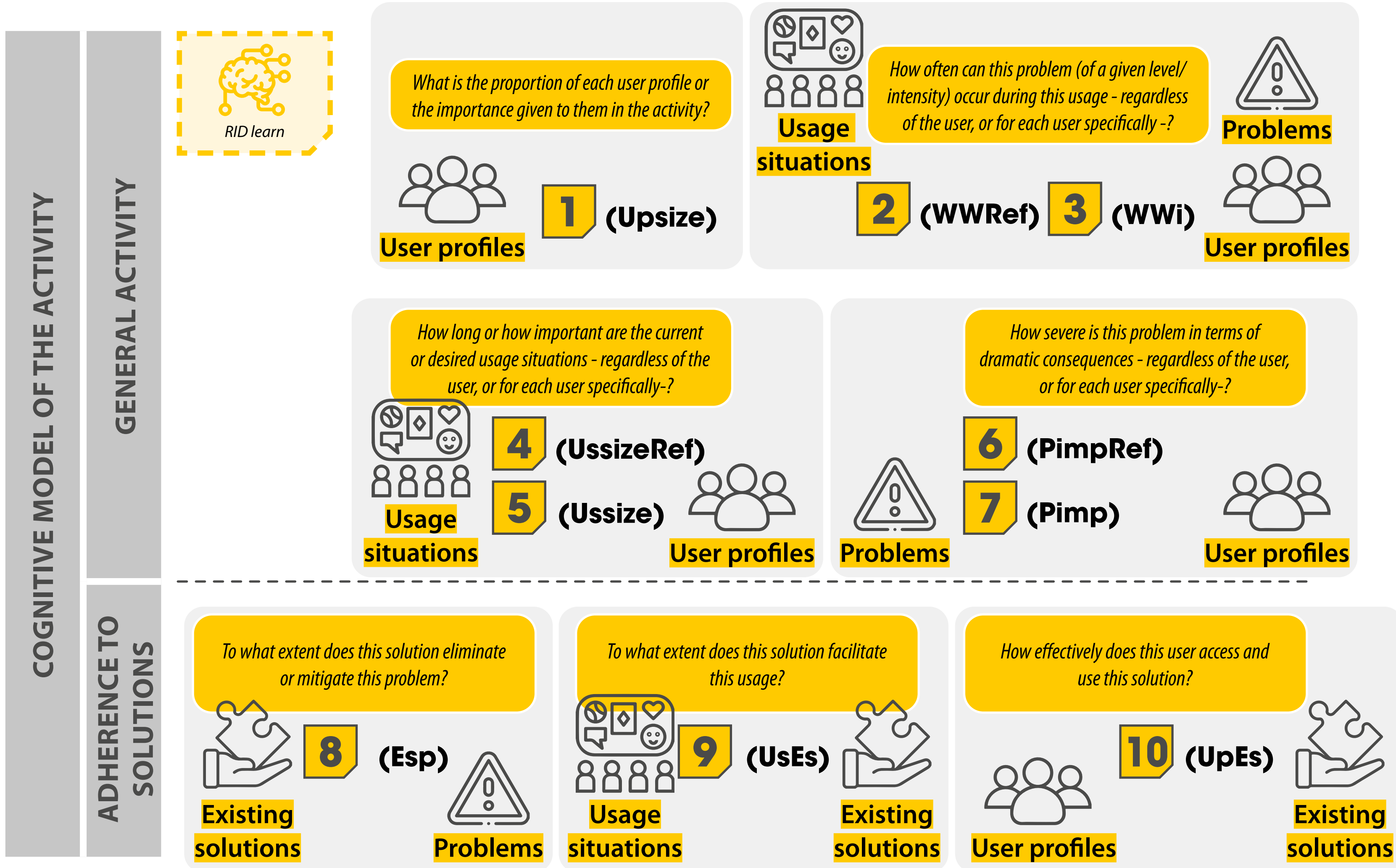
## Build a cognitive model of how people experience current activity (or a component in a system)

Once the parameterization of the activity has been completed, the **cognitive model** is built using **seven questions** on one, two or three activity dimensions at a time (among user profiles, usage situations, problems, existing solutions).

**These questions are very simple**, and experts and users are appropriately queried on specific questions to contribute to a systemic representation of the activity practice.

We use **seven semi-quantitative measurement scales to intuitively answer these questions**. For instance, we often use scales from 0 for "never" or "no importance" to 5 for "frequently" or "very important", or we can decide to use a percentage between 0 and 100% if more natural.

In practice, ten matrices – of 1, 2, or 3 dimensions – are filled in. They all have a specific designation. Three matrices, denoted (Ref)* permit to consider that all user profiles are behaving and perceiving the same manner, which allows to get more immediate results. Conversely, **one can refine user discrepancies as finely as necessary** with the three no-star matrices.


COGNITIVE MODEL OF THE ACTIVITY
GENERAL ACTIVITY
ADHERENCE TO SOLUTIONS
RID learn
What is the proportion of each user profile or the importance given to them in the activity?
User profiles
1 (Upsize)
Usage situations
How often can this problem (of a given level/ intensity) occur during this usage - regardless of the user, or for each user specifically -?
Problems
2 (WWRef)
3 (WWi)
User profiles
How long or how important are the current or desired usage situations - regardless of the user, or for each user specifically-?
4 (UssizeRef)
5 (Ussize)
Usage situations
User profiles
How severe is this problem in terms of dramatic consequences - regardless of the user, or for each user specifically-?
6 (PimpRef)
7 (Pimp)
Problems
User profiles
To what extent does this solution eliminate or mitigate this problem?
8 (Esp)
Existing solutions
Problems
To what extent does this solution facilitate this usage?
9 (UsEs)
Usage situations
Existing solutions
How effectively does this user access and use this solution?
10 (UpEs)
User profiles
Existing solutions

# 79 Categorizing user profiles

## Parameterization of the "Cleaning solar panels" RID study

The **beneficiaries** of the cleaning activity in this study are solar farms. In this case, **user profiles are not human categories** but categories of solar farms that might behave differently during a cleaning activity. So, what are the **most differentiating factors** of solar farms that influence the performances of this cleaning activity? We have identified two main ones:

- size of solar farms,
- glass quality.

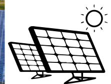
A **judicious combination of user characteristics** yields 4 **categories of user profiles**.

**SOURCE**

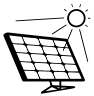
Yannou, B., Lecomte, R., & Cluzel, F. (2024). RID journal paper – RID comparator and Cleaning solar panel study (Version V1). Zenodo.

## Two typical sizes of solar farms

big



small

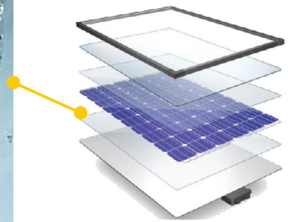


We define a *big* power plant a solar power plant that produces at 10 MWp. Considering that on average a solar power panel produces 265 Watts, a 10 MWp plant has around 38k solar panels installed and it occupies around 60 acres of land. *Smaller* power plants are those that produce 500 kW at peak and occupy less area. Panels that are installed on rooftops enter this category.
This classification of the solar plants (following the peak power production) is based on the current PV panels' distribution.

## Two kinds of glass quality

Tempered or structural glass

Structure of a solar panel



Annealed or float glass

Tempered glass is about 4 times stronger than annealed glass. In addition, tempered glass breaks into small fragments, reducing probability of serious injury. Tempered glasses are also less sensitive to wear and tear due to intensive or aggressive cleaning.

Most (but not all) solar panels on the market use it despite its greater weight and higher cost.

| Categories of user profiles | |
|---|---|
| S | Big plant (10 MWp) with structural glass |
| F | Big plant (10 MWp) with float glass |
| S | Small plant (500 kWp) with structural glass |
| F | Small plant (500 kWp) with float glass |

kWp means kiloWatt-peak

RID STUDY DOWNLOADABLE

# 80 Categorizing usage situations

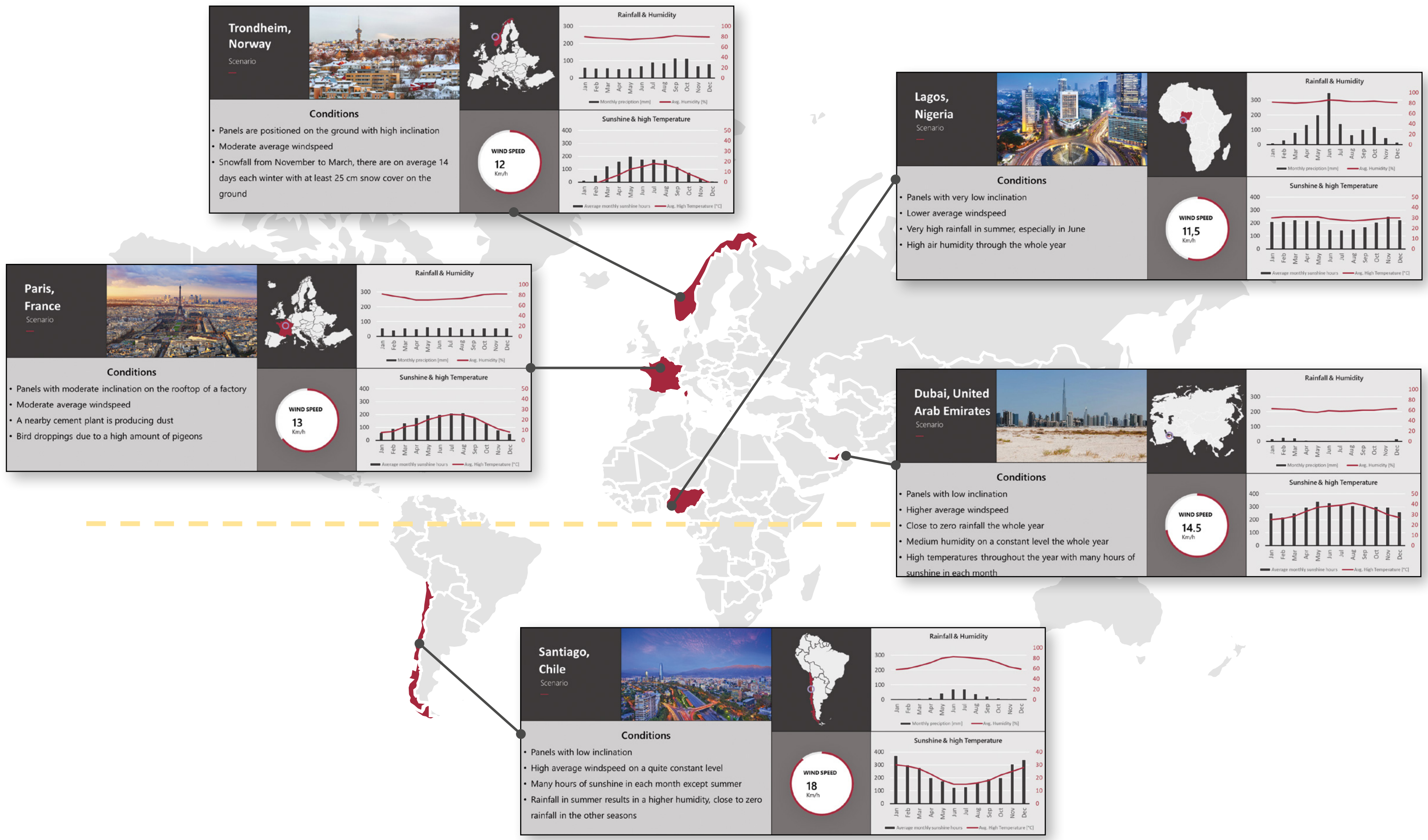
## Parameterization of the "Cleaning solar panels" RID study

The decomposition of the "solar panel cleaning" usage situations can be interpreted in two different ways:

**1.** by globally **considering different activity conditions**,

**2.** by **listing different generic episodes or sub-processes** of a complete cleaning process.

We have considered in this situation the first case (which is quite rare) and have chosen the **location of the solar farm** as the only differentiating factor, since it completely determines the **climatic conditions** (sun, wind, storms) and the **types of soil** to be cleaned: organic matter (pollen, bird droppings or ashes produced by cars and industrial activities), inorganic matter (quartz, calcite, dolomite, kaolinite ...), snow.


Trondheim, Norway
Scenario
Rainfall & Humidity
Sunshine & high Temperature
Conditions
Panels are positioned on the ground with high inclination
Moderate average windspeed
Snowfall from November to March, there are on average 14 days each winter with at least 25 cm snow cover on the ground
WIND SPEED
12
Km/h
Lagos, Nigeria
Scenario
Rainfall & Humidity
Sunshine & high Temperature
Conditions
Panels with very low inclination
Lower average windspeed
Very high rainfall in summer, especially in June
High air humidity through the whole year
WIND SPEED
11,5
Km/h
Paris, France
Scenario
Rainfall & Humidity
Sunshine & high Temperature
Conditions
Panels with moderate inclination on the rooftop of a factory
Moderate average windspeed
A nearby cement plant is producing dust
Bird droppings due to a high amount of pigeons
WIND SPEED
13
Km/h
Dubai, United Arab Emirates
Scenario
Rainfall & Humidity
Sunshine & high Temperature
Conditions
Panels with low inclination
Higher average windspeed
Close to zero rainfall the whole year
Medium humidity on a constant level the whole year
High temperatures throughout the year with many hours of sunshine in each month
WIND SPEED
14.5
Km/h
Santiago, Chile
Scenario
Rainfall & Humidity
Sunshine & high Temperature
Conditions
Panels with low inclination
High average windspeed on a quite constant level
Many hours of sunshine in each month except summer
Rainfall in summer results in a higher humidity, close to zero rainfall in the other seasons
WIND SPEED
18
Km/h

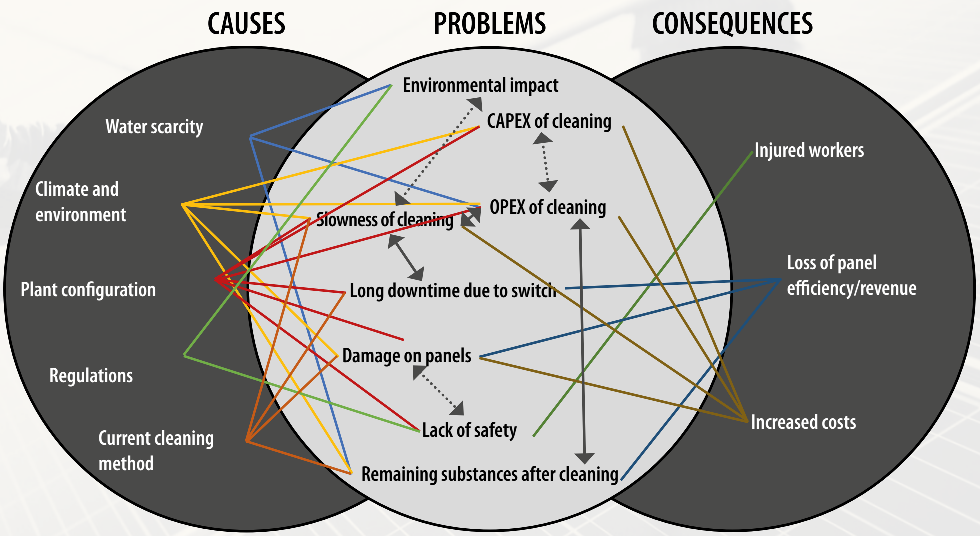
# 81 Categorizing problems

## Parameterization of the "Cleaning solar panels" RID study

The **problems relating to the activity** are classically related to:

- **Costs:** CAPEX and OPEX
- **Quality:** remaining substances after cleaning, lack of safety for operator
- **Time:** slowness of cleaning, long downtime to switch between lines
- **Environment:** water and material consumption

### Causal graph linking problems, causes and consequences



| Problems | | Definition |
|---|---|---|
| | Slowness of cleaning | The cleaning speed of the existing solutions is different and so the time spent in the cleaning varies consequently. |
| | Lack of safety (for operator) and safety requirements | Handling of the tools, working at height, replacing worn parts can be risky activities performed by cleaning operators in daily life. |
| | Environmental impact: water and material consumption | The consumption of water, electricity and other consumable parts impact on the environmental performance of the cleaning activity. |
| | Damage on the panels | Different types of damage to solar panels occur: macro damages, cracks, micro-cracks and localized defects. The damage directly affects the lifetime of PV panels, impacting the economic performance of the farms. |
| | Long downtime to switch between lines | The time to move the cleaning tool from one line to the other, since solar farms are usually organized in several lines of panels divided by aisles. |
| | Remaining substances after cleaning | The quantity of dust/soiling/dirt that is not removed by the cleaning operations. This problem strongly affects the efficiency of the solar panel considering the power outcome. |
| | CAPEX cleaning costs | Capital expenditure refers to funds that are used by a company for the purchase, improvement, or maintenance of long-term assets to improve the efficiency or capacity of the company. An example is the purchase of the equipment needed for cleaning: robots, brushes etc. |
| | OPEX cleaning costs | Operational expenditure consists of those expenses that a business incurs to run smoothly every single day. They are the costs that a business incurs while in the process of turning its inventory into a product. An example is the cost of the maintenance of the equipment and reusable brushes. |

# 82 Categorizing existing solutions

## Parameterization of the "Cleaning solar panels" RID study

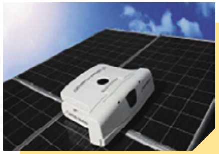
Existing solutions are inventoried and classified into categories with significant differences in properties with respect to users, usage situations and problems.

It can be noted that solutions like "coating systems" and "manual tools" are **not exclusive solutions**. Consequently, the required **mathematical partitioning** is not guaranteed. In addition, some **hybrid solutions** can be considered. But the RID algorithms still give excellent results.

### A kind of **covered problems representation**

| Category | Capex | Water usage | Labor usage | Potential for damage |
|---|---|---|---|---|
| Manual tools | Low | High | Very high | High |
| Mechanized tools | High | Medium-high | Medium-low | Medium-high |
| Installed hydraulic systems | Medium | Very high | Low | Low |
| Installed robotic systems | Medium | Very high | Low | Low |
| Autonomous robots | Medium | Low | Medium | Medium-low |
| Coating systems | Low | Low | Medium | Low |
| Venturi method | Medium | Low | Low | Low |
| Ampere's law | Medium | Low | Low | Medium |

| Category | Definitions and comments |
| --- | --- |
| Manual tools | This method requires a human operator to clean manually with the help of mop or any wipers with suitable support. The quality of cleaned surface is judged visually by the operator him/herself for the satisfactory level or till the dust particles get wiped out completely. The process is found to be very tedious and challenging as the solar power plants consists of numbers of panels installed at a height of 12 to 20 feet or more from the ground. The time required and safety of the person and panel is at risk. To clean the panels manually the fluids like cleansers or gels must be used which act upon the panel and reduce the surface transparency if cleaning is not good enough. There is a risk of damage to the PV panels which cannot be avoided. |
| Mechanized tools | Mechanized tools help the operator in performing better cleaning than manual tools. |
| Installed hydraulic systems | Installed hydraulic systems use a huge quantity of water and the final effectiveness of the cleaning operations strongly depends on the soiling type. For heavy soiling deposition, this kind of solution is quite ineffective. |
| Installed robotic systems | As a general view, robots move along the panels and clean the surface with the use of brushes and/or wipers. Robots can be guided by frames/rails or can freely move on the PV panels surface. This difference is kept in the categorization of the existing solution: the first ones are called installed robotic systems, the second ones autonomous robots. The cleaning efficiency of the robots is high, in fact they perform dry and wet cleaning. The combination of mechanical action with water provides good final cleaning results, so they are deployed in different atmospheric and geographical areas. The working autonomy of robot depends on the software installed in it and on the storage capacity of the battery. A water tank is sometimes installed inside the automatic device. However, the high cost, the complexity of execution and the electricity requirement are some of the disadvantages in using robots. |
| Autonomous robots | Autonomous washing solutions are typically only targeted for extremely high dust regions where annual energy production losses from module soiling can be as high as 5%/year. Waterless systems bring additional benefits for projects located in remote deserted areas. |
| Coating systems | Among the self-cleaning methods of solar panels, coatings represent one of the latest technologies that are under analysis by the scientific community. They are a cheap and simple solution, but do not shield panels from all types of soiling. So, PV glass coatings requires a lot of improvement towards outdoor applications in terms of performance reliability. |
| Venturi method | The principle of operation is based on the laws of aerodynamics: differential pressure creates a directed air flow that blows away dirt and loose snow. This method does not require external resources and it is simple. However, it is only suitable for windy places and does not provide protection from all types of pollution. |
| Ampere's law | The cleaning system based on the principle of Ampere's law relies on the passing of alternating current through the wires in different directions. In this way, as the panel vibrates, cleaning occurs. This is an autonomous system that also allows the removal of snow. The main disadvantage is the electricity requirement. |




# 83 Size or importance of user profiles

*What is the proportion of each user profile or the importance given to them in the activity?*

**User profiles**

**1 (Upsize)**

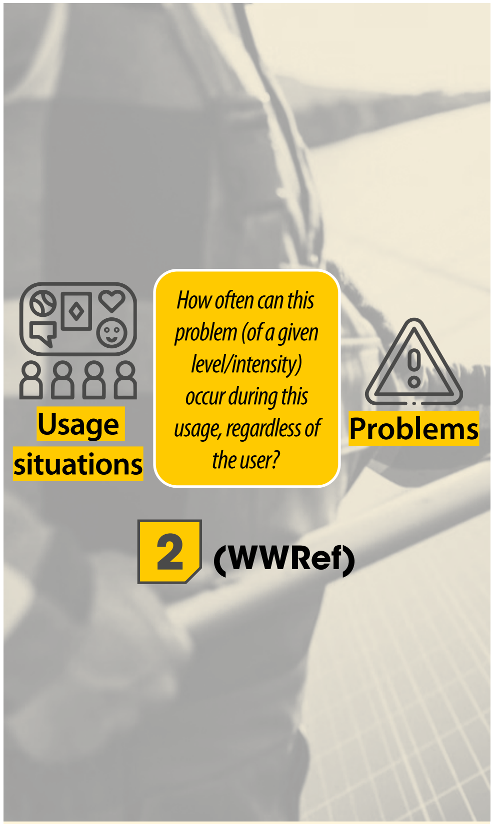
***Upsize* matrix**

| | |
|---|---|
| Big plants structural glass | **25%** |
| Big plants float glass | **25%** |
| Small plants structural glass | **25%** |
| Small plants float glass | **25%** |

## Hypotheses and comments

- By default, with RID, we want to help the stakeholders of an activity according to their number. The larger the number of stakeholders, the more we will want to alleviate their pain and support their activities, and the larger the corresponding value buckets. Conversely, orphan problems attached to very specific populations will tend to be erased, unless the project group decides to restrict its innovations to a few niche markets, which is an entirely laudable choice, but the project group must be aware of this marketing choice. This is precisely what the **RID comparator** makes possible.
- Another way to weight the user profiles is with the importance of the market size that is given to them in terms of expected profit. In this case, it is decided that the importance of the 4 markets of solar panel cleaning is of equal importance.

# 84 Frequency of problems in general




## Deep knowledge has been investigated

- In the Arabian desert (like for Dubai in UAE), the main **soiling** process is **cementation** due to the presence of dust (which is mainly sand) in the air (the sky is not visibly blue) and the high humidity (the morning dew). This cementation requires cleaning operations on average every two weeks, **accounting for most of the operating costs of a solar farm**. Today solar farm operators try to use **dry cleaning** as much as they can with tools such as mops or robotic brushes (nylon hair). This cleaning is triggered when the electrical production drops between 80 - 85% of its maximum capacity. But wet cleaning is mandatory every 2 months to restore the maximum capacity of the panels. **Wet cleaning** can be optimized while spraying with a water hose, but unfortunately a lot of water is wasted in this process.
- Local cleaning subcontractors still use **manual cleaning** in the place of **automatic cleaning equipment**. They avoid these solutions because the current **robots** have major problems with their durability and return on investment. In fact, buying automatic solutions is not an optimal solution for all working conditions, for example, for the cleaning of small areas in the case of a roof farm. Another factor for choosing manual cleaning is the low cost of labor in third world countries.

## Hypotheses and comments

- The slowness of the cleaning procedure in Dubai and Lagos occurs since the level of soiling in these regions is extremely high. Also, considering the cementation process, the time needed for performing the cleaning lengthens.
- Large quantities of substances remain after cleaning the solar panels in Dubai and Lagos, due to the low precipitation levels throughout the year.
- The CAPEX problem is mainly faced in Dubai and Lagos because solar farm managers must deal with extreme conditions in terms of soiling (i.e., high expenditure in cleaning tool).
- The OPEX problem is linked with Trondheim and Paris since they are locations where labor and consumable costs are high.

### *WWRef* matrix

| | Slowness of cleaning | Lack of safety | Environmental impact | Damage on panels | Long downtime | Remaining substances | CAPEX | OPEX |
|---|---|---|---|---|---|---|---|---|
| Trondheim | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 4 |
| Paris | 4 | 3 | 2 | 2 | 3 | 3 | 3 | 4 |
| Dubai | 5 | 3 | 3 | 4 | 3 | 4 | 4 | 2 |
| Lagos | 5 | 3 | 3 | 4 | 3 | 4 | 4 | 2 |
| Santiago | 4 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |

# 85 Frequency of problems by user profiles


## Hypotheses and comments

As mentioned above, completing just the WWRef matrix with the **frequency of problems** regardless of user profiles can be sufficient to get an initial result. But things can be modulated by considering the specificities of user profiles. Let us look at the two notable differences in these user profiles:

- the main difference between big and small plant is related to the environmental impact (consumption of water and materials) and the slowness of the cleaning procedure.
- the main difference between structural and float glass is about damage on the panels and slowness of cleaning procedure. The strength of float glass is lower and the cleaning operations are faster when dealing with structural glass.

| Big plants with structural glass | Slowness of cleaning | Lack of safety | Environmental impact | Damage on panels | Long downtime | Remaining substances | CAPEX | OPEX |
|---|---|---|---|---|---|---|---|---|
| Trondheim | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 4 |
| Paris | 4 | 4 | 3 | 2 | 3 | 3 | 3 | 4 |
| Dubai | 5 | 3 | 4 | 4 | 3 | 4 | 4 | 2 |
| Lagos | 5 | 3 | 4 | 4 | 3 | 4 | 4 | 2 |
| Santiago | 4 | 3 | 4 | 2 | 3 | 3 | 3 | 3 |

***WW1* matrix**

| Big plants with float glass | Slowness of cleaning | Lack of safety | Environmental impact | Damage on panels | Long downtime | Remaining substances | CAPEX | OPEX |
|---|---|---|---|---|---|---|---|---|
| Trondheim | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 4 |
| Paris | 3 | 4 | 3 | 3 | 3 | 3 | 3 | 4 |
| Dubai | 4 | 3 | 4 | 5 | 3 | 4 | 4 | 2 |
| Lagos | 4 | 3 | 4 | 5 | 3 | 4 | 4 | 2 |
| Santiago | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 3 |

***WW2* matrix**

| Small plants with structural glass | Slowness of cleaning | Lack of safety | Environmental impact | Damage on panels | Long downtime | Remaining substances | CAPEX | OPEX |
|---|---|---|---|---|---|---|---|---|
| Trondheim | 2 | 3 | 1 | 2 | 3 | 3 | 3 | 4 |
| Paris | 3 | 4 | 2 | 2 | 3 | 3 | 3 | 4 |
| Dubai | 4 | 3 | 3 | 4 | 3 | 4 | 4 | 2 |
| Lagos | 4 | 3 | 3 | 4 | 3 | 4 | 4 | 2 |
| Santiago | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |

***WW3* matrix**

| Small plants with float glass | Slowness of cleaning | Lack of safety | Environmental impact | Damage on panels | Long downtime | Remaining substances | CAPEX | OPEX |
|---|---|---|---|---|---|---|---|---|
| Trondheim | 1 | 3 | 1 | 3 | 3 | 3 | 3 | 4 |
| Paris | 2 | 4 | 2 | 3 | 3 | 3 | 3 | 4 |
| Dubai | 3 | 3 | 3 | 5 | 3 | 4 | 4 | 2 |
| Lagos | 3 | 3 | 3 | 5 | 3 | 4 | 4 | 2 |
| Santiago | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

***WW4* matrix**

# 86 Duration or importance of usage situations in general

*How long or how important are the current or desired usage situations regardless of the user?*

**4** **(UssizeRef)**

**Usage situations**

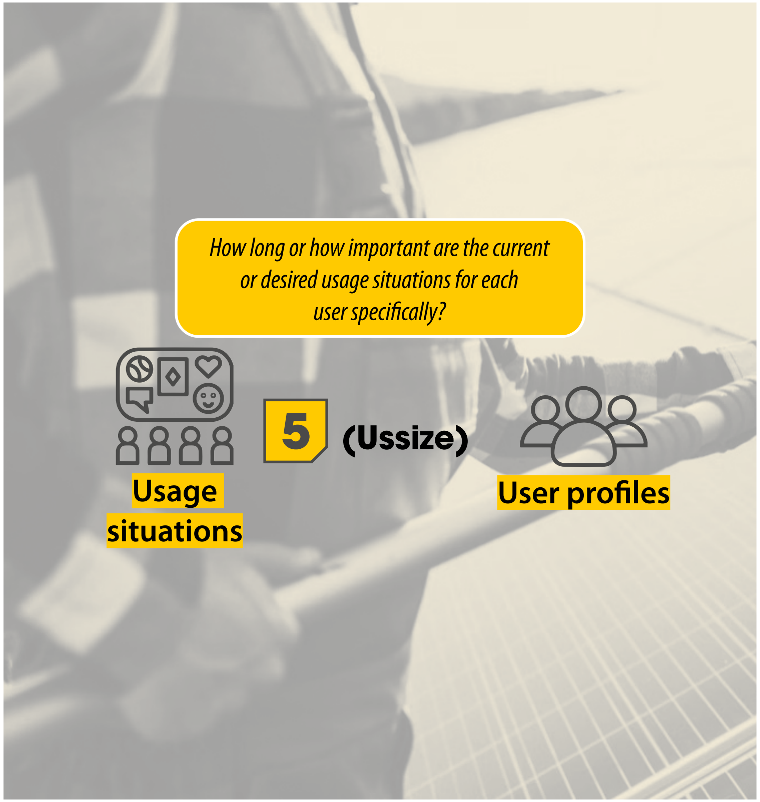
## ***UssizeRef* matrix**

| Trondheim | Paris | Dubai | Lagos | Santiago |
|---|---|---|---|---|
| 8% | 14% | 32% | 24% | 22% |

## Hypotheses and comments

- The **duration or importance of a usage situation** must be sometimes interpreted. In the most frequent case, when usage situations are associated with generic episodes, sub-processes or tasks of the activity, then the **relative duration of usage situations** is often chosen. In the less frequent case when usage situations are associated with different activity conditions (this is the case here), then either the **proportion of these activity conditions** or the **relative importance of these activity conditions** can be chosen.
- In our case of "cleaning solar panels", it should be observed that most of the energy produced by solar plants comes from Dubai and Lagos. The 2 regions are quite close to the equator, and they experience a high number of sunny days along the year (Dubai about 3500 annual hours of sunshine and Lagos about 2500 annual hours of sunshine). We adopted this **measure of annual hours of sunshine to express the relative importance of the usage situations**.

# 87 Duration or importance of usage situations by user profiles




## Hypotheses and comments

- Again, we can choose to introduce modulations in the duration or importance of usage situations for each user profile. We must then ask ourselves **how the user profiles have affinities or spend more or less time in the usage situations**.
- In this "cleaning solar panels" case, we estimated an approximate distribution of the types of solar farms (our user profiles) in the different countries (the usage situations). Indeed, big plants (and consequently relevant power produced) are located in hot areas, while the **small plants are located in mountain and industrial environments**.
- Our RID algorithms can take into account qualitative estimates (here on a scale from 0 to 5), percentages or even a scale of a particular physical measure. This must be decided once and for all when completing the matrix.

## *UssizeRef* matrix

| Trondheim | Paris | Dubai | Lagos | Santiago |
|---|---|---|---|---|
| 8% | 14% | 32% | 24% | 22% |

| | Trondheim | Paris | Dubai | Lagos | Santiago |
|---|---|---|---|---|---|
| Big plants with structural glass | 1 | 2 | 5 | 4 | 3 |
| Big plants with float glass | 1 | 2 | 5 | 4 | 3 |
| Small plants with structural glass | 4 | 4 | 2 | 2 | 3 |
| Small plants with float glass | 4 | 4 | 2 | 2 | 3 |

## *Ussize* matrix

# 88 Severity of problems

*How severe is this problem in terms of dramatic consequences regardless of the user?*

Problems

6 (PimpRef)

***PimpRef* matrix**

| Slowness of cleaning | Lack of safety | Environmental impact | Damage on panels | Long downtime | Remaining substances | CAPEX | OPEX |
|---|---|---|---|---|---|---|---|
| 8.00% | 12.00% | 11.00% | 14.00% | 8.00% | 16.00% | 14.00% | 17.00% |

| Slowness of cleaning | Lack of safety | Environmental impact | Damage on panels | Long downtime | Remaining substances | CAPEX | OPEX | |
|---|---|---|---|---|---|---|---|---|
| 7.10% | 10.70% | 10.70% | 14.30% | 7.10% | 17.90% | 14.30% | 17.90% | |
| 2 | 3 | 3 | 4 | 2 | 5 | 4 | 5 | 28 |

## Hypotheses and comments

- The importance of problems must be estimated in terms of the **severity of their consequences**. Here, the causal graph linking causes to problems and consequences is used to establish orders of magnitude in terms of dramatic consequences. Of course, the project group must consider how it can balance the economic, safety, and environmental consequences. The Knowledge design is important for gathering useful information, but the project group can express its sensitivity.
- In practice, we propose **two approaches to converge to a weighting with a group**:

1. We choose a simple rating scale like 0 to 5 or 0 to 10. Then we determine the most important problems and give it the maximum score. We do the same with the least important problems, and next we scale the rating for problems of intermediate importance. Finally, we can possibly transform these weightings into percentages and slightly modify the importance of some percentages.
2. We use for instance the "Geometric mean over rows or columns" pairwise comparison method to qualitatively compare importance ratios of problem importances pairwise (row/column ratio estimates) in a square matrix of problems against problems [Yannou & Limayem, 2022b]. By doing so we reduce the complexity of the judgment by simply estimating the relative importance of two problems at once, and thanks to a formula the final weights are determined.

*SOURCE*

Yannou, B., & Limayem, F. (2002a). Les méthodes de comparaison par paires - Intérêt fondamental, Méthodes pratiques, Avancées scientifiques, Logiciel - Première partie: Intérêt fondamental. *La Valeur des produits, procédés et services*, 92(avril 2002), 15-18.
Yannou, B., & Limayem, F. (2002b). Les méthodes de comparaison par paires - Intérêt fondamental, Méthodes pratiques, Avancées scientifiques, Logiciel - Deuxième partie: Les méthodes classiques et des avancées récentes. *La Valeur des produits, procédés et services*, 93(septembre 2002), 15-18.
Yannou, B., & Limayem, F. (2002c). Les méthodes de comparaison par paires - Intérêt fondamental, Méthodes pratiques, Avancées scientifiques, Logiciel - Troisième partie: Logiciel TCMC et exemple. *La Valeur des produits, procédés et services*, octobre 2002.

# 89 Severity of problems by user profiles


## Hypotheses and comments

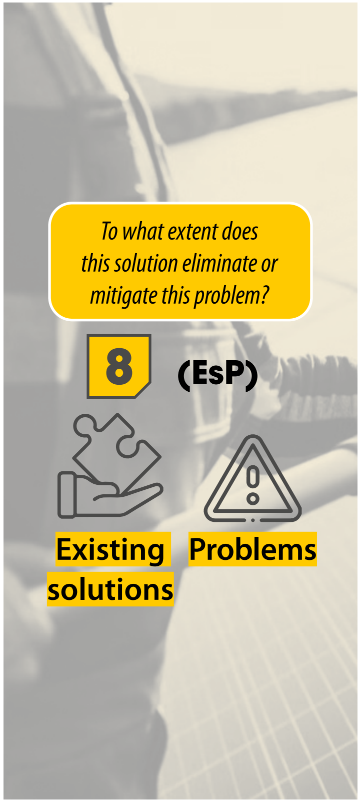
- Again, it may be relevant to express **how the different user profiles are more or less sensitive to problems**.
- In our case:
  - Damage on panels is greater with float glass, which wears out more quickly.
  - Environmental impact is more important for big plants.
  - Slowness of cleaning is more important, as well as more difficult to control, for big plants. It is also all the more important for structured glasses.

## *PimpRef* matrix

| | Slowness of cleaning | Lack of safety | Environmental impact | Damage on panels | Long downtime | Remaining substances | CAPEX | OPEX |
|---|---|---|---|---|---|---|---|---|
| | 8.00% | 12.00% | 11.00% | 14.00% | 8.00% | 16.00% | 14.00% | 17.00% |

| | Slowness of cleaning | Lack of safety | Environmental impact | Damage on panels | Long downtime | Remaining substances | CAPEX | OPEX |
|---|---|---|---|---|---|---|---|---|
| Big plants structural glass | 3 | 3 | 3 | 3 | 2 | 5 | 4 | 5 |
| Big plants float glass | 2 | 3 | 3 | 4 | 2 | 5 | 4 | 5 |
| Small plants structural glass | 1 | 3 | 2 | 3 | 2 | 5 | 4 | 5 |
| Small plants float glass | 0 | 3 | 2 | 4 | 2 | 5 | 4 | 5 |

# 90 Level of problem solving for existing solutions




## Hypotheses and comments

- After the investigation in the **Knowledge design** stage, we observed **how different existing solutions solve specific problems**:
  - Manual tools are usually slow and operators can cause damages to the panels, both in terms of cracks and macro damage. However, the quality of the cleaning is high, keeping CAPEX quite low.
  - Installed hydraulic systems use a huge quantity of water and the final effectiveness of the cleaning operations strongly depends on the soiling type. For heavy soiling deposition, this kind of solution is quite ineffective.
  - Installed robotic systems and autonomous robots are useful devices for cleaning solar panels. Their overall performance is quite good, specially looking the remaining substances and at the OPEX problem. The autonomous ones can also easily be moved between different lines of panels.
  - The Venturi method solves a lot of the identified problems, even if the method works only in specific atmospheric conditions (i.e. windy areas).
  - The Ampere method is based on the use of electric current for removing dust and sand from the panels. Its effectiveness strongly depends on the soiling typology. CAPEX and OPEX are medium-low.

## *EsP* matrix

| | Slowness of cleaning | Lack of safety | Environmental impact | Damage on panels | Long downtime | Remaining substances | CAPEX | OPEX |
|---|---|---|---|---|---|---|---|---|
| Manual tools | 1 | 1 | 1 | 1 | 4 | 4 | 5 | 1 |
| Mechanized tools | 2 | 2 | 2 | 2 | 4 | 4 | 3 | 2 |
| Installed hydraulic systems | 4 | 5 | 0 | 5 | 5 | 2 | 2 | 3 |
| Installed robotic systems | 4 | 4 | 2 | 4 | 2 | 4 | 3 | 4 |
| Autonomous robots | 3 | 4 | 4 | 4 | 3 | 4 | 3 | 3 |
| Coating system | 5 | 5 | 5 | 4 | 5 | 1 | 4 | 4 |
| Venturi method | 5 | 5 | 5 | 5 | 5 | 2 | 3 | 5 |
| Ampere method | 4 | 4 | 3 | 4 | 5 | 3 | 3 | 4 |

# 91 Level of usage facilitation for existing solutions


## Hypotheses and comments

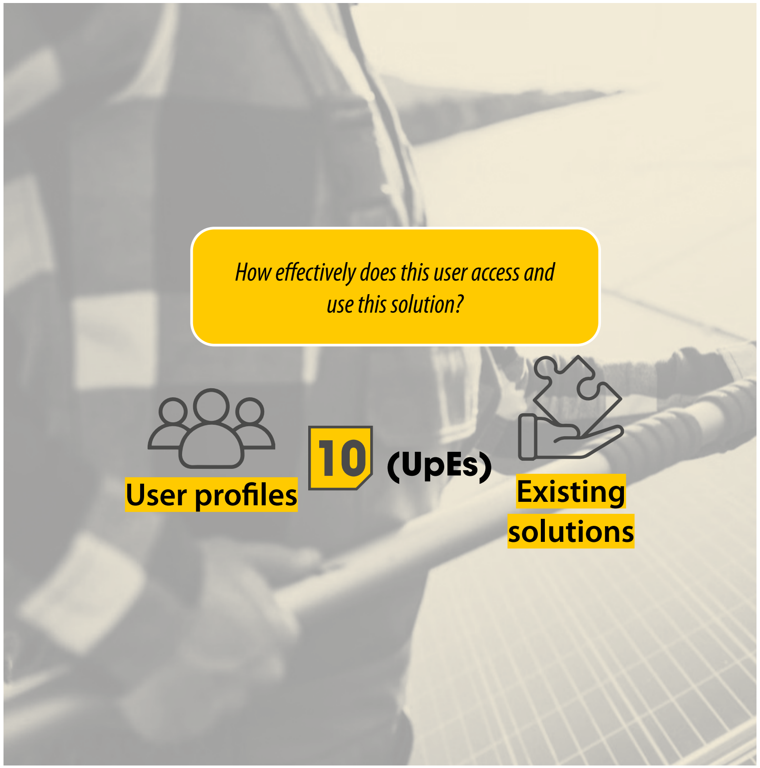
After the investigation in the **Knowledge design** stage, we observed **how different existing solutions are adapted to specific usage situations**:

- it is straightforward to understand how manual and mechanized tools are suitable for most of the 5 usage scenarios.
- Installed robotic systems facilitate the cleaning operations, especially in Lagos.
- On the other hand, coating systems are good for moderate soiling, for example in Trondheim and Paris.
- The Venturi method works perfectly in windy places in order to take advantage of air fluxes: Santiago is the only location that satisfies this requirement.

## *UsEs* matrix

| | Manual tools | Mechanized tools | Installed hydraulic systems | Installed robotic systems | Autonomous robots | Coating system | Venturi method | Ampere method |
|---|---|---|---|---|---|---|---|---|
| Trondheim | 4 | 5 | 1 | 3 | 2 | 4 | 3 | 2 |
| Paris | 3 | 4 | 3 | 4 | 4 | 4 | 2 | 2 |
| Dubai | 5 | 5 | 2 | 4 | 3 | 2 | 1 | 3 |
| Lagos | 5 | 5 | 3 | 5 | 4 | 3 | 1 | 2 |
| Santiago | 5 | 5 | 2 | 4 | 3 | 4 | 5 | 3 |

# 92 Effectiveness of access to solutions by user profiles




## Hypotheses and comments

After the investigation in the **Knowledge design** stage, we observed **how different existing solutions are accessible, effectively used and adapted to specific user profiles**:

- For big plants, installed robots are preferable because of the large surface to clean, and coatings provide help in the cleaning operations.
- Regarding the covering of the PV panel, float glass is more suitable for autonomous robots and coating systems thank to its final finish.
- Regarding glass quality, similar reasonings can be made for small plants.
- Manual and mechanized tools are suitable for small plants, thanks to their high flexibility.

## *UpEs* matrix

| | Manual tools | Mechanized tools | Installed hydraulic systems | Installed robotic systems | Autonomous robots | Coating system | Venturi method | Ampere method | Modular system |
|---|---|---|---|---|---|---|---|---|---|
| Big plants with structural glass | 2 | 3 | 2 | 5 | 3 | 3 | 3 | 3 | 4 |
| Big plants with float glass | 2 | 3 | 2 | 5 | 4 | 4 | 4 | 4 | 5 |
| Small plants with structural glass | 4 | 4 | 3 | 4 | 3 | 3 | 3 | 3 | 3 |
| Small plants with float glass | 4 | 4 | 3 | 4 | 4 | 4 | 4 | 4 | 4 |

# Chapter 7

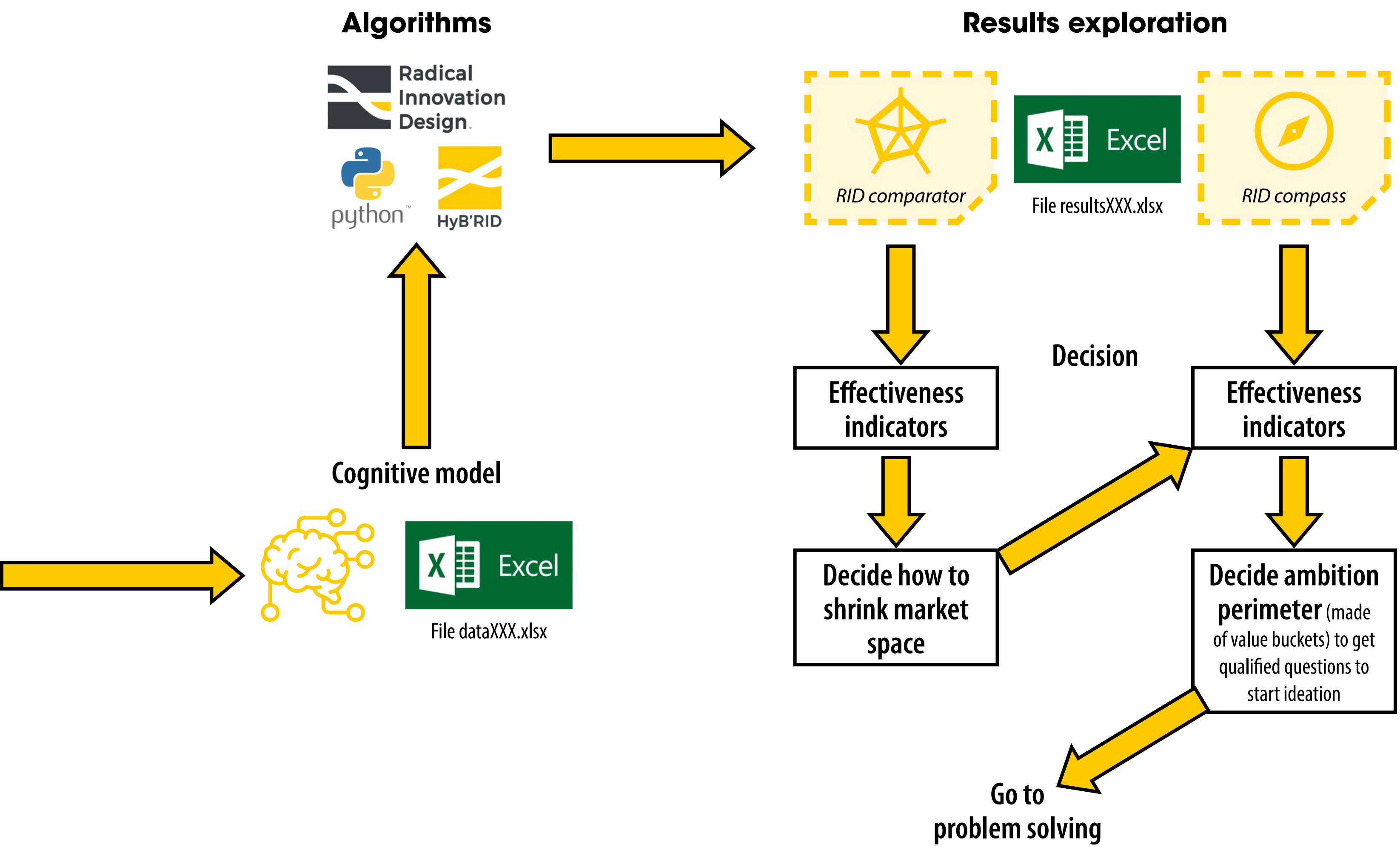
## Explore & decide

The innovation cockpit

# 93 The process of feeding and exploring the cognitive model

The **problem design** stage mainly consists of (i) **parameterizing the activity**, **inputting data** and validating the **cognitive model**, and (ii) **exploring the current activity** and deciding which innovation paths are worth pursuing in the **problem solving**. This second part is automated by original algorithms which allow designers (a) to assess comparatively the effectiveness of existing solutions and decide which market to conquer (RID comparator), and (b) to decide which qualified questions to start ideation with (RID compass).

| | |
|---|---|
| **General activity** | 1. Size or importance of user profiles (**Upsize**) |
| | 2. Frequency of problems in general (**WWRef**) |
| | 3. Frequency of problems by user profiles (**WWi**) |
| | 4. Duration or importance of usage situations in general (**UssizeRef**) |
| | 5. Duration or importance of usage situations by user profiles (**Ussize**) |
| | 6. Severity of the problems in general (**PimpRef**) |
| | 7. Severity of problems by user profiles (**Pimp**) |
| **Adherence to solutions** | 8. Level of problem solving for existing solutions (**EsP**) |
| | 9. Level of usage facilitation for existing solutions (**UsEs**) |
| | 10. Effectiveness of access to solutions by user profiles (**UpEs**) |



Algorithms
Radical Innovation Design.
python
HyB'RID
Results exploration
RID comparator
Excel
File resultsXXX.xlsx
RID compass
Decision
Effectiveness indicators
Effectiveness indicators
Cognitive model
Excel
File dataXXX.xlsx
Decide how to shrink market space
Decide ambition perimeter (made of value buckets) to get qualified questions to start ideation
Go to problem solving

# 94 The quantities of pain... for dummies

An elementary **quantity of pain** is a portion of **problems** experienced by a given **user** in a given **usage situation**, and which can be partially or totally lessened by a given **existing solution**.
The diagram below on the activity "*Cooking and enjoying French fries*" displays matrices of quantities of pain at 3 different stages.

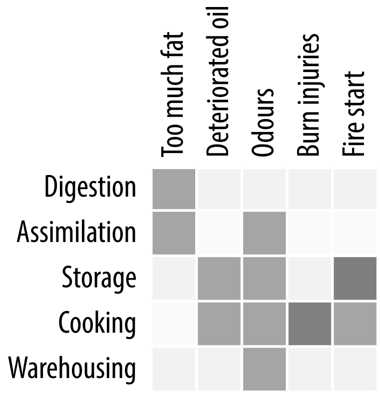
**Activity:** Cooking and enjoying French fries

Knowledge Design

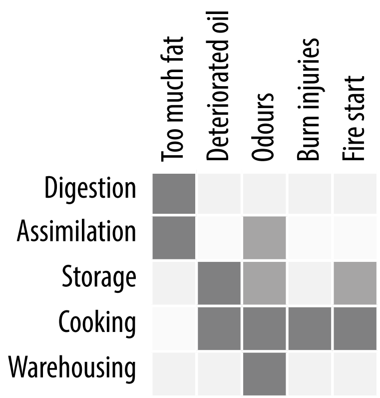
| Problems | Usage situations |
|---|---|
| Too much fat | Digestion and Assimilation |
| Deteriorated oil | Storage and Cooking |
| Odours | Cooking and Warehousing |
| Burn injuries | Cooking |
| Fire start | Cooking |

Mapping problems and usage situations, in general, whatever a particular solution.

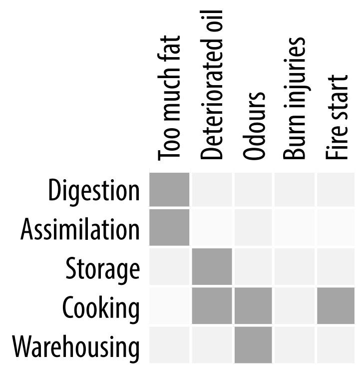
Some **existing solutions** have the **"ability to lessen some quantities of pain"**, i.e. some problems in a given situation for a given **user**.




The What's Wrong *WW* matrix that expresses the **"initial quantities of pain to be removed for considering an ideal activity"**




Maybe we should try to specifically innovate on this! The matrix of **value buckets**




SEB

A disruptive **"need seeker"** innovative solution:

VIDEO LINK Actifry by Seb/Tefal

**SOURCE**

Bekhradi A., Yannou B., Cluzel F., Vallette T., 2017. Categorizing users' pains, usage situations and existing solutions in front end of innovation: The case of smart lighting project, In *21st International Conference on Engineering Design (ICED)*, August 21-25, Vancouver, Canada.

# 95 The quantities of pain… played by dummies

Pick a first card in the **usage/activity** deck. Then pick a series of **problem** cards and improvise, as fast as you can, a one-sentence story based on your personal experience. Imagine the perfect match while evoking a **quantity of pain**! Different game modes exist: fast & furious, battle…

USAGE FIELD CARD

**Gardening**

+

PROBLEM CARD

**Bad first experience**

=

**Example**

*"the first time I planted salads, when they were just starting to grow, the slugs ate them all in 2 days."*

## Usage/activity cards

## Problem cards


MICRO TOOL DOWNLOADABLE

# 96 The quantities of pain... explained by maths

## Notations

*Up*, *Us*, *P*, *Es*: vectors of (respectively) user profiles, usage situations, problems, existing solutions
$\forall i, j, k, l \in [Up, Us, P, Es]$

## Pre-treatments

Matrices *WW*, *UpEs*, *UsEs*, *EsP* are **adimensioned** with their proper scale:

$$\forall i,j,k,l,\ WW_{ijk} \leftarrow \frac{WW_{ijk}}{Scale_{WW}}$$

Matrices $Us_{size}$, $P_{imp}$, $Up_{size}$ are **normalized**:

$$\forall i,j \qquad Us_{size_{ij}} \leftarrow Us_{size_{ij}} \Big/ \sum_{z=1}^{J} Us_{size_{iz}}$$

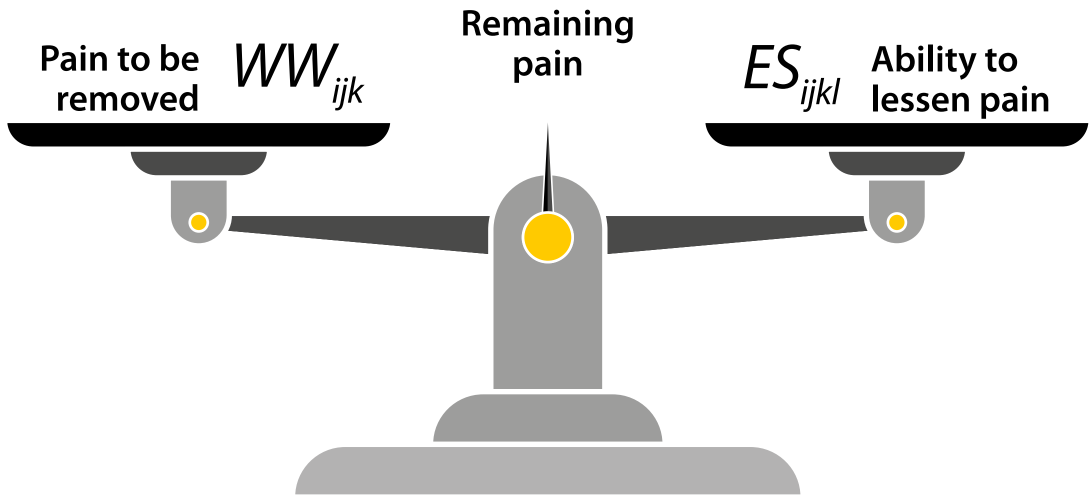
The 3D matrix *WW* expresses the "**initial quantities of pain to be removed for considering an ideal activity**", assimilable to quantities of pain:

$$WW_{ijk}$$

The 4D matrix *ES* is computed by multiplication of the three matrices *UsEs*, *EsP*, and *UpEs* for expressing the "**ability of a solution to lessen quantities of pain**", i.e. the problems in a given situation for a given user:

$$ES_{ijkl} = UsEs_{lj}.EsP_{lk}.UpEs_{il}$$

The comparison between the two matrices $WW_{ijk}$ and $ES_{ijkl}$ leads to two decision indicators: the **effectiveness indicators** and the **value buckets**.




***SOURCE***
Lecomte, R., & Yannou, B. (2024). RID journal paper - RID study Falls of the elderly (Version V1). Zenodo.

# 97 The decision indicators explained by maths

*RID comparator*

The 4D $E_{UpUsPEs}$ matrix expresses the **elementary effectiveness of solution *l***, i.e. the **percentage of pain removal offered by solution *l***:

$$E_{UpUsPEs_{ijkl}} = \begin{cases} \dfrac{ES_{ijkl}}{WW_{ijk}} & \text{if } WW_{ijk} > ES_{ijkl} \\ 1 & \text{otherwise} \end{cases}$$

The **seven evolved effectiveness indicators:**

Effectiveness of solutions for pairs: usage situations and problems

$$\forall\ j,k \in [Us,P] \quad E_{UsP_{jk}} = \sum_{i \in Up} E_{UpUsP_{ijk}} . Up_{size_i}$$

Effectiveness of solutions for pairs: user profiles and problems

$$\forall\ i,k \in [Up,P] \quad E_{UpP_{ik}} = \sum_{j \in Us} E_{UpUsP_{ijk}} . Us_{size_{ij}}$$

Effectiveness of solutions for pairs: user profiles and usage situations

$$\forall\ i,j \in [Up,Us] \quad E_{UpUs_{ij}} = \sum_{k \in P} E_{UpUsP_{ijk}} . P_{imp_{ik}}$$

Effectiveness of solutions for problems

$$\forall\ k \in P \quad E_{P_k} = \sum_{\substack{i \in Up \\ j \in Us}} E_{UpUsP_{ijk}} . Us_{size_{ij}} . Up_{size_i}$$

Effectiveness of solutions for usage situations

$$\forall\ j \in Us \quad E_{Us_j} = \sum_{\substack{i \in Up \\ k \in P}} E_{UpUsP_{ijk}} . P_{imp_{ik}} . Up_{size_i}$$

Effectiveness of solutions for user profiles

$$\forall\ i \in Up \quad E_{Up_i} = \sum_{\substack{j \in Us \\ k \in P}} E_{UpUsP_{ijk}} . P_{imp_{ik}} . Us_{size_{ij}}$$

Global effectiveness of solutions

$$E = \sum_{\substack{i \in Up \\ j \in Us \\ k \in P}} E_{UpUsP_{ijk}} . P_{imp_{ik}} . Us_{size_{ij}} . Up_{size_i}$$

The multiplicity of these indicators will make it possible to explore where **existing solutions** are not very effective, and where it would therefore be a good idea to provide users with **innovative solutions**.

*RID compass*

The 3D *ES2* matrix expresses the "**averaged ability of market solutions to lessen quantities of pain**":

$$ES2_{ijk} = \frac{\sum_{l=1}^{L} ES_{ijkl}}{Max_{a,b,c}\left(\sum_{d=1}^{L} UsEs_{cd} \times EsP_{db} \times UpEs_{ad}\right)} \times Min\left(Max_{jl}\left(UsEs_{jl}\right), Max_{lk}\left(EsP_{lk}\right), Max_{il}\left(UpEs_{il}\right)\right)$$

The 3D *SUB* matrix expresses the "**elementary value buckets where one should innovate on**", given that it is advised to innovate where there is usefulness expectations from users ($WW_{ijk}$ high) and where the solution competitors are less effective on average ($ES2_{ijk}$ low):

$$SUB_{ijk} = 100 \times Max\left(0; WW_{ijk} - ES2_{ijk}\right)$$

The *AllUsers* **and the *I*** $SpecificUser_i$ **Value Bucket matrices** express, respectively, the value buckets "**where one should innovate**" independently of the categories of user profiles, and the value buckets "**where one should innovate for a given user category**":

$$SpecificUserVB_{ijk} = SUB_{ijk} \times Us_{size_{ij}} \times P_{imp_{ik}}$$

$$AllUsersVB_{jk} = \frac{1}{I} \times \sum_{i=1}^{I} SpecificUserVB_{ijk} \times Up_{size_i}$$


**SOURCE**

Kim C.W., Mauborgne R., 2005. Blue ocean strategy - How to create uncontested market space and make the competition irrelevant, Boston, USA/MA: Harvard Business School press, ISBN: 978-1-5913-9619-2.

Yannou, B., Lecomte, R., & Cluzel, F. (2024). RID journal paper – RID comparator and Cleaning solar panel study (Version V1). Zenodo.

# 98 The qualities of "quantities of pain" metrics

**Quantity of pain metrics** has been designed so as to be **extensive [Stevens]**, i.e. to be able to be summed and to permit comparisons to be made.

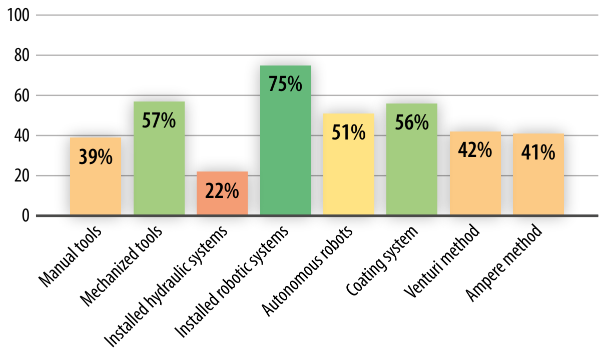
This is why the formulas expressing the **effectiveness indicators in the RID comparator**, as well as **value buckets in the RID compass**, are appropriate **weighted averages** of the elementary effectiveness indicators, respectively value buckets. These weighted averages $P_{imp_{ik}}.Us_{size_{ij}}.Up_{size_i}$ guarantee that:

- the larger the user segment, the larger the quantity of pain,
- the more frequent the usage situation, the larger the quantity of pain,
- the more severe the problem, the larger the quantity of pain.

*RID comparator*

The **global effectiveness indicator** shows at a glance which solution is the most dominant, whatever the users, usage situations and problems. However, it will often be useful to analyze in greater depth where the effectiveness of a particular solution is dominant, depending on the user, usage situation or problem concerned.

$$E = \sum_{\substack{i \in Up \\ j \in Us \\ k \in P}} E_{UpUsP_{ijk}} . P_{imp_{ik}} . US_{size_{ij}} . UP_{size_i}$$




*RID compass*

The *AllUsers* **Value Bucket matrix** expresses at a glance where the best places are that would merit innovation for the reason that there is usefulness to be created for users and competitors are ineffective. These places are designated by pairs of (user profile category X problem category). These interesting places are in green in the matrix below.

$$AllUsersVB_{jk} = \frac{1}{I} \times \sum_{i=1}^{I} \begin{matrix} 100 \times Max\left(0; WW_{ijk} - ES2_{ijk}\right) \\ \times US_{size_{ij}} \times P_{imp_{ik}} \times UP_{size_i} \end{matrix}$$

| | Tiredness | Visibility | Physical pain | Movement restrictions | Lack of attention | Discomfort | Anxiety | Memory |
|---|---|---|---|---|---|---|---|---|
| Sitting down | 4 | 0 | 15 | 20 | 0 | 9 | 4 | 0 |
| Putting and removing seat belt | 4 | 0 | 15 | 16 | 0 | 9 | 0 | 0 |
| Wearing the seat belt | 0 | 0 | 15 | 0 | 0 | 12 | 8 | 0 |
| Deposition of personal things | 0 | 0 | 9 | 7.2 | 0 | 5.4 | 9.6 | 0 |
| Adjusting the seat | 0 | 0 | 6 | 8 | 0 | 3.6 | 0 | 4 |
| Adjusting the mirrors | 0 | 3.6 | 0 | 2.4 | 9.6 | 0 | 2.4 | 6 |
| Adjusting the steering wheel | 0 | 1.2 | 0 | 0 | 0 | 0.6 | 0 | 3 |
| Adjusting of the center console | 0 | 7.2 | 4 | 0 | 16 | 4.8 | 12.8 | 16 |
| Adjusting at steering wheel level | 0 | 9 | 0 | 0 | 12 | 0 | 0 | 15 |
| Reacting in critical situations | 1.6 | 0 | 4 | 0 | 8 | 2.4 | 6.4 | 8 |
| Driving on a long journey | 8 | 4.8 | 10 | 1.6 | 8 | 6 | 8 | 0 |
| Driving on a road in poor conditions | 8 | 2.4 | 4 | 1.6 | 6.4 | 4.8 | 8 | 0 |
| Driving on a fast road | 3.2 | 2.4 | 2 | 0 | 3.2 | 1.8 | 4 | 1 |
| Driving against the light | 7.2 | 9 | 3 | 0 | 7.2 | 3.6 | 7.2 | 0 |
| Reaction at an intersection | 6.4 | 7.2 | 0 | 12.8 | 16 | 4.8 | 12.8 | 4 |
| Maneuver to park within the city | 7.2 | 7.2 | 6 | 7.2 | 2.4 | 5.4 | 12 | 3 |
| Getting out of the vehicle | 4 | 0 | 20 | 20 | 0 | 12 | 4 | 0 |


***SOURCE***

Stevens, S. S. (1946). On the Theory of Scales of Measurement. *Science, 103(2684), 677-680.*

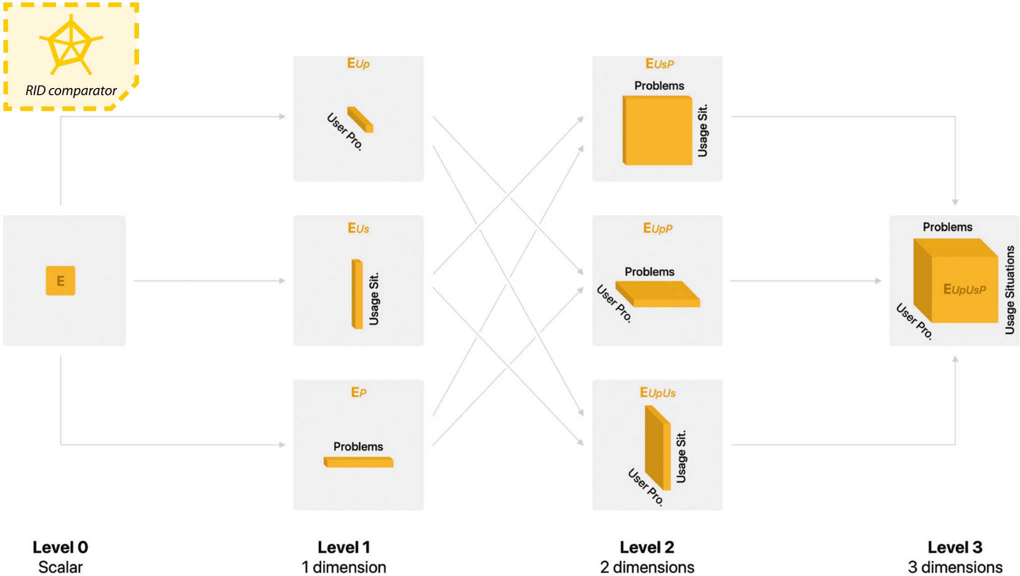
Stevens, S. S. (1951). Mathematics, Measurement and Psychophysics. In S. S. Stevens (Ed.), *Handbook of Experimental Psychology (pp. 1-49). New-York: John Wiley & Sons,* ISBN: 978-1-1191-7016-7.

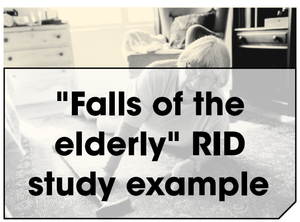
# 99 The RID comparator and the 8 effectiveness indicators

We invented **effectiveness indicators** to assess the ability of solutions to lessen **quantities of pains**. **Effectiveness indicators** are calculated for each solution and are denoted $E_x$, where $E$ is "effectiveness" and $x$ is an index that identifies each of the 8 indicator types. They provide four levels of aggregation (from 0 to 3) depending on the desired level of detail desired about **user profiles, usage situations** or **problems**.

For all indicators, a value of 100% means that the solution lessens the entire initial quantity of pain, or that there was no pain to begin with. A value of 0% means that the solution has no influence on the initial quantity of pain.

- Aggregation level 0 corresponds to the most aggregated indicator – simply termed E – which allows a single effectiveness value for a solution. This is the most comprehensive indicator but also the least detailed since the most aggregated. Therefore, we have broken it down into 7 other indicators with varying degrees of granularity.
- Level 1 deepens in one dimension according to user profiles, usage situations or problems, referred to as $E_{Us}$, $E_{Up}$ and $E_P$ respectively. For example, if we want to know the effectiveness of a solution for a specific user profile, we will look for the value of $E_{Up}$ corresponding to this user. These indicators are vectors.
- Level 2 deepens in two dimensions between user profiles, usage situations and problems. They are referred to as $E_{UsP}$, $E_{UpUs}$ and $E_{UpP}$ and are 2D matrices.
- Level 3 is the most precise, presenting the effectiveness of a solution according to the three dimensions (user profiles, usage situations and problems). The corresponding indicator is a 3D matrix noted $E_{UpUsP}$. This is the most complex indicator, but it is also the only one that obtains the effectiveness corresponding to a specific problem, for a specific user, during a specific usage situation.




**Existing solutions:**

Passive wristband/pendant at home (PH)

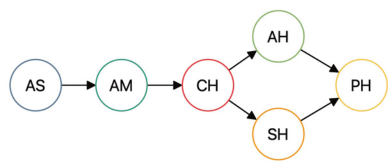
Active wristband/pendant at home (AH)

Active wristand/pendant mobile (AM)

Active wristand/pendant Sigfox (AS)

Cameras at home (CH)

Sensors at home (SH)




*SOURCE*

Yannou, B., Lecomte, R., & Cluzel, F. (2024). RID journal paper – RID comparator and Cleaning solar panel study (Version V1). Zenodo.

Kim, C. W., & Mauborgne, R. (2005). Blue ocean strategy - *How to create uncontested market space and make the competition irrelevant*. Boston, USA/MA: Harvard Business School press, ISBN: 978-1-5913-9619-2.

Christensen, C. (2003). *The Innovator's Solution: Creating and Sustaining Successful Growth:* Harvard Business School Press, ISBN: 978-1-4221-9657-1.

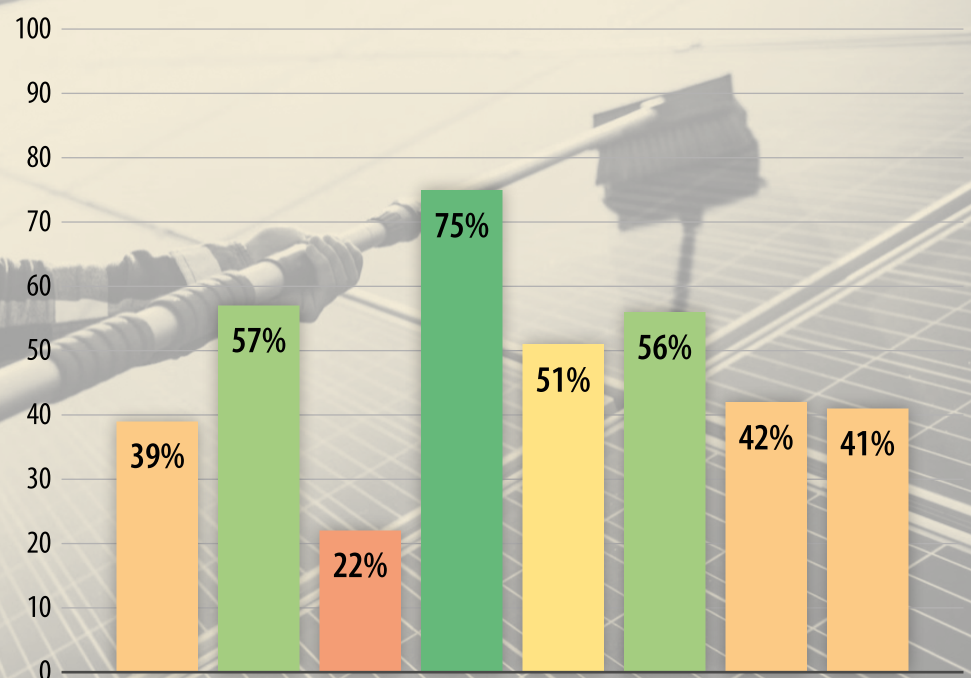
## What are effectiveness indicators for?

The **comparison between effectiveness indicators** of existing solutions allows us to reveal:

- the **competitive advantages** of existing solutions,
- the **degree of accomplishment** of existing solutions in the ideal goal of an activity,
- **where there is still usefulness to create,**
- **which shrinking of the market space it is relevant to operate,**
- the **dominance graph** of existing solutions under a specific viewpoint (user profiles, usages situations, or problems).

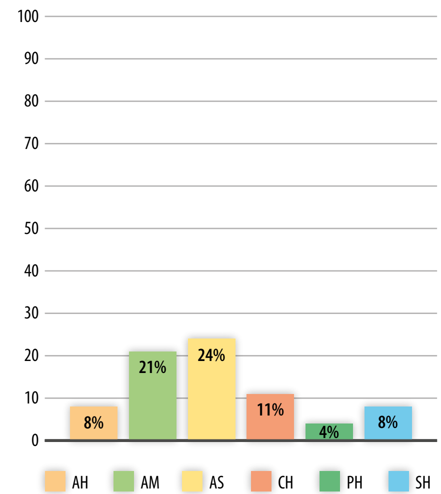
# 100 Analyzing global effectiveness indicator


| Existing solutions | Effectiveness |
|---|---|
| Manual tools | **39%** |
| Mechanized tools | **57%** |
| Installed hydraulic systems | **22%** |
| Installed robotic systems | **75%** |
| Autonomous robots | **51%** |
| Coating system | **56%** |
| Venturi method | **42%** |
| Ampere method | **41%** |

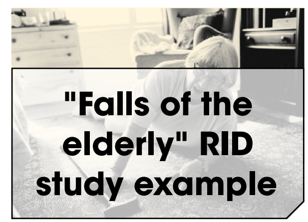


# Analysis

- As mentioned above, it is the most comprehensive **effectiveness indicator** but also the least detailed since the most aggregated.
- Usually, solutions that achieve **more than 50% global effectiveness** indicate an already considerable optimization. **These solutions are very versatile and universal**: they solve several problems at once, adapt to various usage situations and are suitable for various users.
- When a good proportion of existing solutions exceed 50% of effectiveness, one can say that **the market is mature** and it will probably be difficult to surprise the market with a new disruptive solution. When a solution has, in such a market, a low effectiveness (30% or less), we can say that if it remains, it is **because it must surpass the others in niche contexts**. When RID modeling is sufficiently fine-tuned, the **use of effectiveness indicators of dimensions 2 and 3** makes it possible to find these **local dominance zones**, which are expressed by user/usage, user/problem, or problem/usage combinations.
- When all the existing solutions in the markets corresponding to an activity have a low effectiveness (less than 25%), we can legitimately say that **there has been no serious study of usage**, that **the potential for innovation is strong** and that an innovative and ambitious company has a future. This is the case of the "detection and alert of elderly falls" activity that we studied.




**Existing solutions:**
Passive wristband/pendant at home (PH)
Active wristband/pendant at home (AH)
Active wristand/pendant mobile (AM)
Active wristand/pendant Sigfox (AS)
Cameras at home (CH)
Sensors at home (SH)




*SOURCE*
Yannou, B., Lecomte, R., & Cluzel, F. (2024). RID journal paper – RID comparator and Cleaning solar panel study (Version V1). Zenodo.

# 101 Which effectiveness for problems?

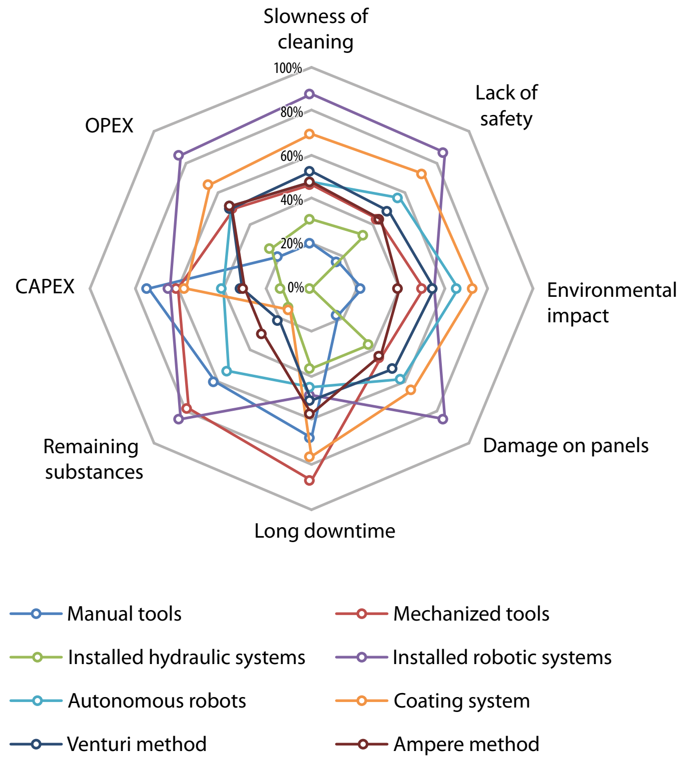
RID comparator

## Analysis and possible decision

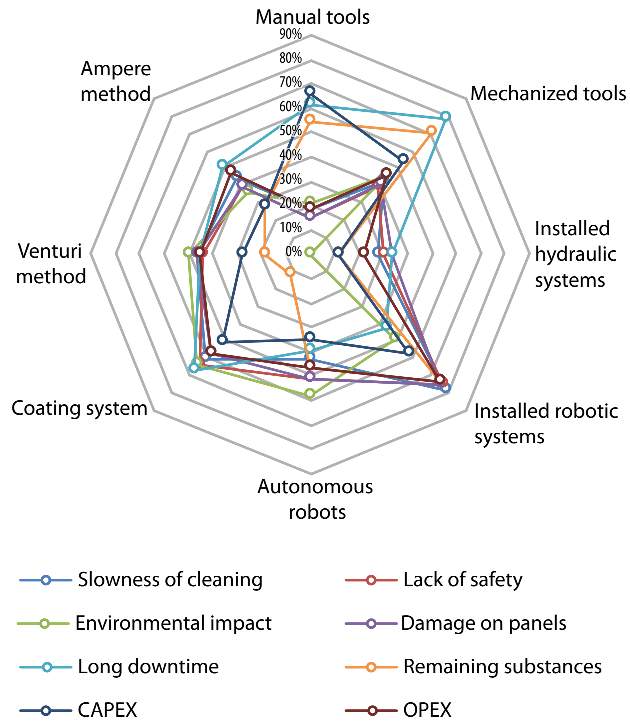
**The first Indicator reveals the effectiveness of the existing solutions against problems and vice-versa:**

- The *installed robotic system* solves many of the problems (i.e. the score obtained by this solution is high in many categories of problems), **except for long downtime to switch between lines**.
- *Coating systems* and *mechanized tools* perform well, even if the former one does not solve the remaining substances problem and the latter the damage on the panels and the CAPEX.
- *Autonomous robots* are environmentally friendly and effective in cleaning, however they are **expensive and quite slow**.
- *Installed hydraulic systems* **consume a lot of water and are not able to clean all the types of soiling**.

| Effectiveness of solutions for problems | Slowness of cleaning | Lack of safety | Environmental impact | Damage on panels | Long downtime | Remaining substances | CAPEX | OPEX |
|---|---|---|---|---|---|---|---|---|
| Manual tools | 20% | 17% | 23% | 17% | 68% | 61% | 73% | 20% |
| Mechanized tools | 47% | 43% | 5% | 45% | 87% | 78% | 60% | 50% |
| Installed hydraulic systems | 31% | 34% | 0% | 37% | 37% | 13% | 13% | 25% |
| Installed robotic systems | 88% | 86% | 55% | 85% | 49% | 84% | 64% | 84% |
| Autonomous robots | 48% | 57% | 66% | 58% | 45% | 53% | 40% | 52% |
| Coating system | 69% | 72% | 73% | 65% | 76% | 14% | 57% | 65% |
| Venturi method | 52% | 49% | 56% | 52% | 51% | 21% | 31% | 51% |
| Ampere method | 48% | 44% | 40% | 44% | 57% | 30% | 30% | 52% |




**Effectiveness of solutions against problems**




**Effectiveness of problems against solutions**

# 102 Effectiveness criteria for usage situations

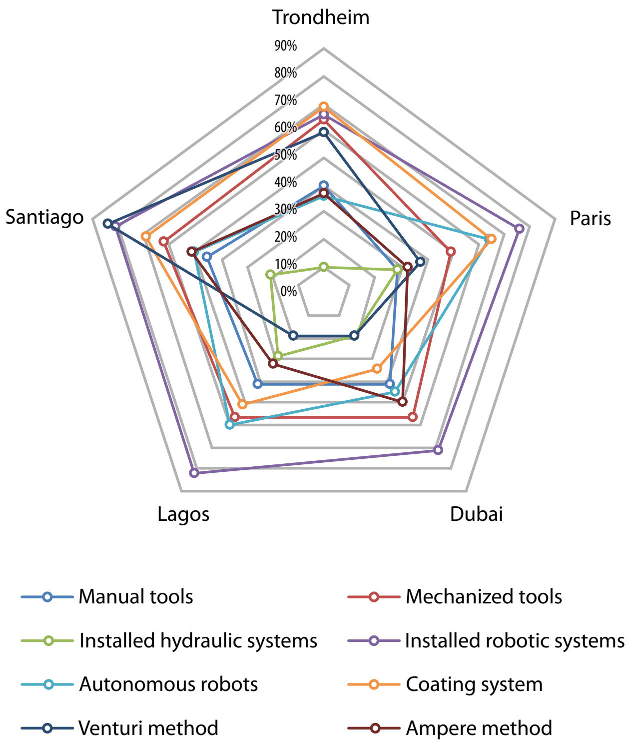
RID comparator

| Effectiveness of solutions for usage situations | Trondheim | Paris | Dubai | Lagos | Santiago |
|---|---|---|---|---|---|
| Manual tools | 40% | 29% | 41% | 41% | 45% |
| Mechanized tools | 64% | 49% | 56% | 56% | 62% |
| Installed hydraulic systems | 10% | 29% | 19% | 29% | 21% |
| Installed robotic systems | 66% | 76% | 71% | 82% | 81% |
| Autonomous robots | 36% | 64% | 45% | 60% | 50% |
| Coating system | 69% | 65% | 34% | 51% | 69% |
| Venturi method | 59% | 37% | 19% | 19% | 84% |
| Ampere method | 37% | 32% | 49% | 32% | 51% |

## Analysis

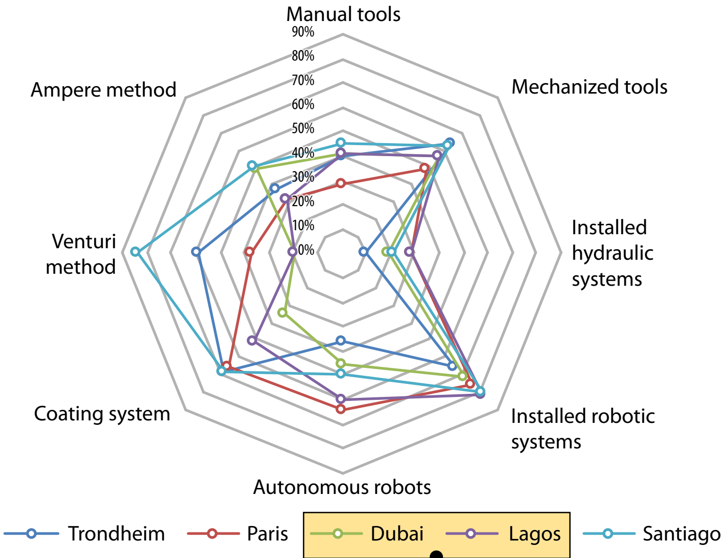
**The second indicator reveals the effectiveness of the existing solutions against the usage situations, and vice-versa:**

- The *Venturi method* works well in Santiago since it is a windy area.
- *Coatings* are useful in Santiago, Trondheim and Paris because cementation of dust does not occur.
- The *installed robotic systems* are a valuable technology for almost all the usage situations.
- *Autonomous robots* are suitable for industrial environments like Paris. Indeed, usually panels are positioned horizontally, and the dust can be easily removed.




**Effectiveness of solutions against usage situations**

**Effectiveness of usage situations against solutions**




**Decision to shrink the market place**

Looking at the usage situations, Dubai is the archetype facing the biggest problems. Low humidity, low rainfall and high presence of dust in the air characterize the location. Lagos suffers also and is a challenging location. For these 2 locations, there is no satisfactory solution on average and there is a lot of quantities of pain remaining.

**We decide to shrink our window of attention to them.**

# 103 Which effectiveness for user profiles?

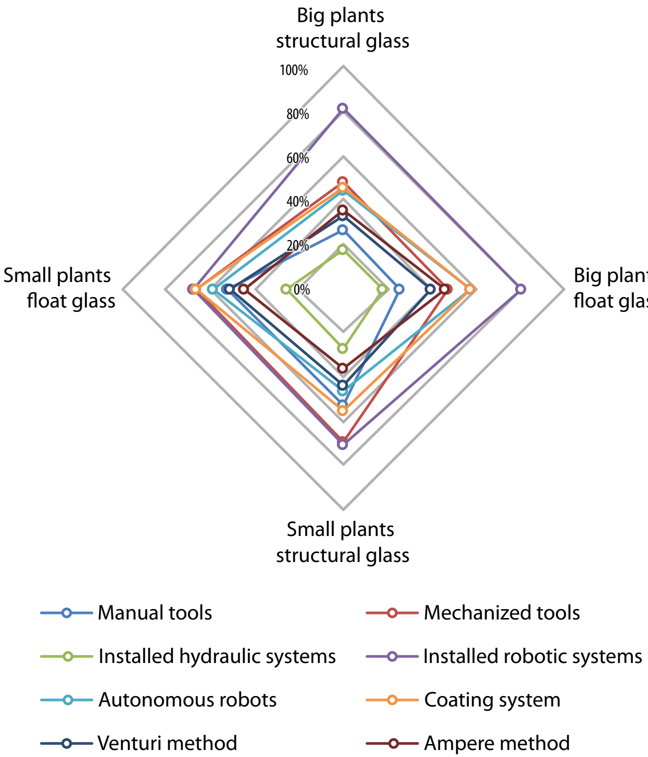
*RID comparator*

| Effectiveness of solutions for user profiles | Big plants structural glass | Big plants float glass | Small plants structural glass | Small plants float glass |
|---|---|---|---|---|
| Manual tools | **26%** | **26%** | **53%** | **52%** |
| Mechanized tools | **48%** | **47%** | **69%** | **66%** |
| Installed hydraulic systems | **18%** | **18%** | **27%** | **25%** |
| Installed robotic systems | **81%** | **81%** | **71%** | **68%** |
| Autonomous robots | **44%** | **57%** | **46%** | **58%** |
| Coating system | **45%** | **58%** | **55%** | **66%** |
| Venturi method | **33%** | **40%** | **44%** | **51%** |
| Ampere method | **35%** | **46%** | **36%** | **45%** |

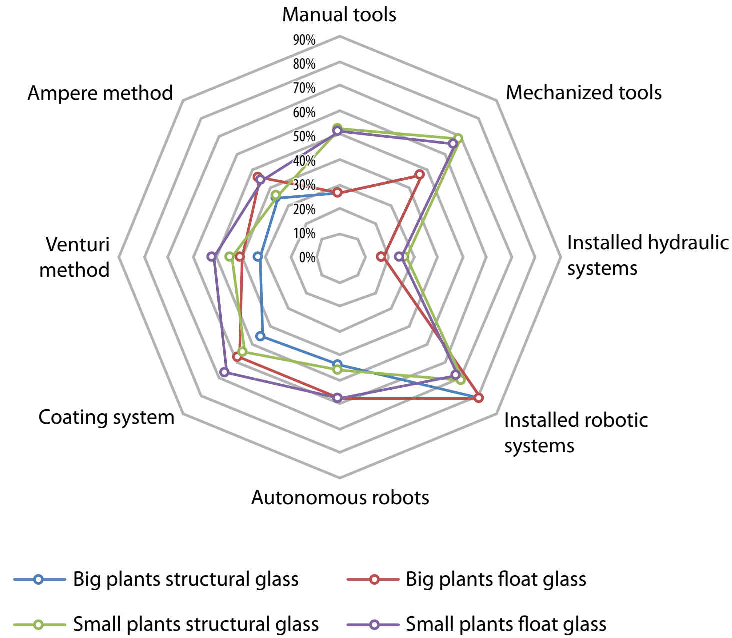
## Analysis and possible decision

**The third indicator reveals the effectiveness of the existing solutions against the users:**

- There is not a strong different trend looking at *structural and float glass*, considering the two main families of plants. Float glass is on average better for the application of coatings and for the deployment of autonomous robots, since the surface is very smooth.
- *Installed robotic systems* are effective for big plants, manual and mechanized tools for small ones. Manual and mechanized tools are affordable even for smaller plants, while installed devices are a good trade-off between costs and cleaning effectiveness for big plants.




**Effectiveness of solutions against user profiles**




**Effectiveness of user profiles against solutions**

# 104 The RID compass and its value buckets

*RID compass*

## Definition

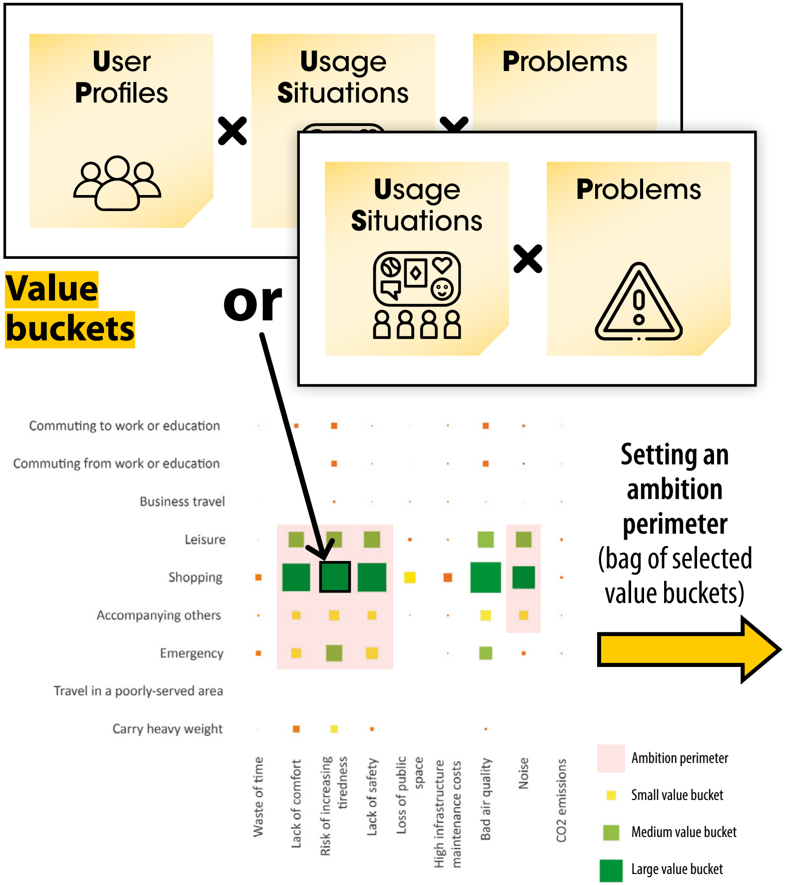
An important **value bucket** is a major problem (i.e., with severe consequences) that arises during a frequent usage situation for all or some users, and for which existing solutions provide too little or no relief (also referred as a lack of **usage coverage**).

In practice, a **value bucket** is either a **triplet (users, situations, problems)** or a **pair (situations, problems)**, implying that all users are concerned in the latter case.

**Value buckets** are computed automatically thanks to **RID compass algorithms**. Value buckets matrices of two kinds are generated: for all users, and for each user.

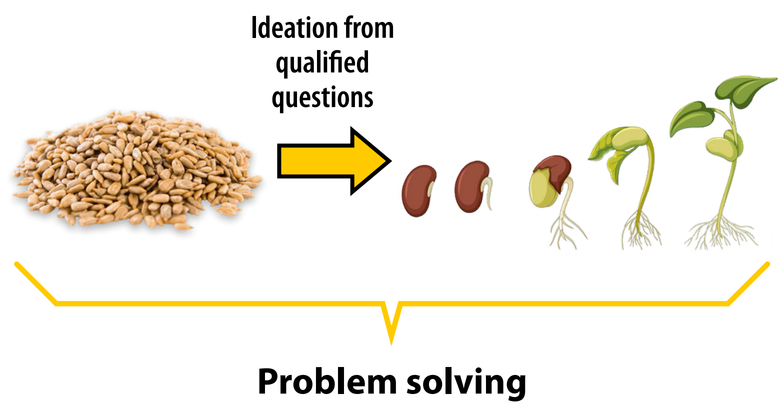
**Value buckets** materialize (qualify and quantify) high value and differentiating innovation leads/opportunities that are worth the effort.

**In RID, the goal is to detect and lessen the importance of major value buckets.** An **ambition perimeter** is constituted as a bag of selected value buckets to start the **problem solving**. These selected value buckets are as many seeds to be germinated. They are precisely **qualified questions**, which makes **ideation** all the more efficient, and their quantification ensures their interest in terms of **usefulness** to be increased for the users. The path to innovation is well defined and secure.




*"I'm not trying to know the answers, I'm trying to understand the questions."*
**Confucius**

*"There is no favorable wind for the sailor who doesn't know where to go."*
**Seneca**




*SOURCE*
Yannou B., Cluzel F., Farel R., 2016. Capturing the relevant problems leading to pain and usage driven innovations: the DSM Value Bucket algorithm. *Concurrent Engineering - Research And Applications (CERA), 1-16.*

# 105 Handling value buckets

Once the raw matrices of **value buckets** has been obtained, it is necessary to:

- **Share a common analysis and understanding within the project group.** The results must be shared and **intensively discussed** by project members and experts. Indeed, some results can confirm intuition, while others may be surprising, which is sometimes justified, but sometimes **it may reveal defects in the model**. It is then sometimes necessary to loop back on the segmentation of users, situations, problems and existing solutions or on the quantification of the cognitive model until the group of experts is satisfied. Once done, the **explanations must be traced**.
- **Determine macro-value-buckets.** It is recommended that all the elementary value buckets **be assembled in a limited number of clusters**, while moving or inverting rows and columns of the matrices. Doing so, macro-value-buckets will be **seeds for ideation** (see **RID creativity tool**). Note that not all combinations are admissible. Indeed, associations of users between them, situations between them, and problems are not all compatible. For instance, situations of installation in car can be assembled but not with the ones of navigating… **The idea is to construct a macro chunk of situated problems that merits to be innovated at once.**

# Example of Accesseat RID study value buckets

| | Tiredness | Visibility | Physical pain | Movement restrictions | Lack of attention | Discomfort | Anxiety | Memory |
|---|---|---|---|---|---|---|---|---|
| Sitting down | 4 | 0 | 15 | 20 | 0 | 9 | 4 | 0 |
| Putting and removing seat belt | 4 | 0 | 15 | 16 | 0 | 9 | 0 | 0 |
| Wearing the seat belt | 0 | 0 | 15 | 0 | 0 | 12 | 8 | 0 |
| Deposition of personal things | 0 | 0 | 9 | 7.2 | 0 | 5.4 | 9.6 | 0 |
| Adjusting the seat | 0 | 0 | 6 | 8 | 0 | 3.6 | 0 | 4 |
| Adjusting the mirrors | 0 | 3.6 | 0 | 2.4 | 9.6 | 0 | 2.4 | 6 |
| Adjusting the steering wheel | 0 | 1.2 | 0 | 0 | 0 | 0.6 | 0 | 3 |
| Adjusting of the center console | 0 | 7.2 | 4 | 0 | 16 | 4.8 | 12.8 | 16 |
| Adjusting at steering wheel level | 0 | 9 | 0 | 0 | 12 | 0 | 0 | 15 |
| Reacting in critical situations | 1.6 | 0 | 4 | 0 | 8 | 2.4 | 6.4 | 8 |
| Driving on a long journey | 8 | 4.8 | 10 | 1.6 | 8 | 6 | 8 | 0 |
| Driving on a road in poor conditions | 8 | 2.4 | 4 | 1.6 | 6.4 | 4.8 | 8 | 0 |
| Driving on a fast road | 3.2 | 2.4 | 2 | 0 | 3.2 | 1.8 | 4 | 1 |
| Driving against the light | 7.2 | 9 | 3 | 0 | 7.2 | 3.6 | 7.2 | 0 |
| Reaction at an intersection | 6.4 | 7.2 | 0 | 12.8 | 16 | 4.8 | 12.8 | 4 |
| Maneuver to park within the city | 7.2 | 7.2 | 6 | 7.2 | 2.4 | 5.4 | 12 | 3 |
| Getting out of the vehicle | 4 | 0 | 20 | 20 | 0 | 12 | 4 | 0 |

Only driver affected

Several User Profiles × Several Usage Situations × Several Problems →

**Definition of a macro-value-bucket**

Drivers & passengers × Sitting down & seat belt & getting out × Physical pain & Mvt restrictions & Discomfort →

**Example of macro-value-bucket #1**
User profiles, usage situations, and problems are gathered in clusters of 2, 2 and 3 categories

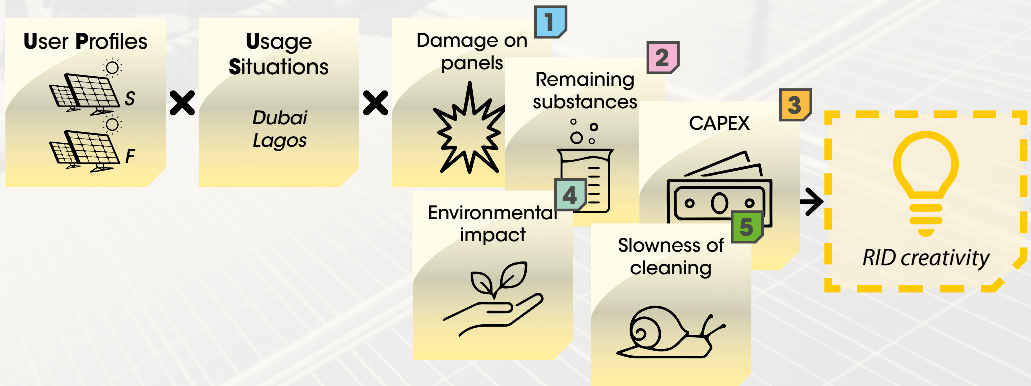
**Illustrated and commented**

# 106 The *AllUsers* value bucket matrix


| All users | Slowness of cleaning | Lack of safety | Environmental impact | Damage on panels | Long downtime | Remaining substances | CAPEX | OPEX |
|---|---|---|---|---|---|---|---|---|
| Trondheim | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.04 | 0.01 | 0.21 |
| Paris | 0.02 | 0.07 | 0.02 | 0.00 | 0.00 | 0.03 | 0.01 | 0.20 |
| Dubai | 0.16 | 0.03 | 0.19 | 0.27 | 0.01 | 0.23 | 0.20 | 0.00 |
| Lagos | 0.10 | 0.00 | 0.13 | 0.17 | 0.00 | 0.14 | 0.12 | 0.00 |
| Santiago | 0.02 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## The five **macro value buckets**

We could have gathered all interesting value buckets into a unique big macro value bucket, but we preferred to separate the 5 problems as they are not similar enough, and creativity will be more efficient.



## Analysis

The RID algorithm reveals the value buckets related to cleaning activity. **Five macro value buckets** are decided, at the intersection of:

- Two usage situations: those corresponding to our decision to shrink the market space, i.e. Dubai and Lagos
- Two user profiles: those corresponding to big plants (see further $SpecificUser_i$ value bucket matrices)
- Five problems: damage on the panels, remaining substances, CAPEX, environmental impact, and slowness of cleaning.

Looking at the steps already undertaken in the RID process, this result is consistent with some reasonings already explained. Dubai and Lagos are the locations that produce the highest quantity of energy since they are close to the equator. So, innovative solutions regarding cleaning for these two locations can strongly impact the economic profitability. CAPEX is a key indicator when economic decisions must be taken, since capital costs are amortized through time. Regarding the cleaning operations, damage to the panels and remaining substances impact on the everyday performance of PV panels. The power outcome usually decreases and so the ideal profitability of the plant is not reached. A similar reasoning can be made with slowness of cleaning. Finally, environmental impact (water and electricity consumption) is also an issue in itself and it is also connected to the revenue generation of the solar farm.

The combination of OPEX, Paris and Trondheim could also be another value bucket (#6), and it is reasonable since the labor and resource costs in Europe is higher than for the other usage situations. However, for the consistent design of an innovate solution, we choose not to consider it to continue with creativity steps.

# 107 The *SpecificUser*$_i$ value bucket matrices

*RID compass*

| All users | Slowness of cleaning | Lack of safety | Environmental impact | Damage on panels | Long downtime | Remaining substances | CAPEX | OPEX |
|---|---|---|---|---|---|---|---|---|
| Trondheim | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.04 | 0.01 | 0.21 |
| Paris | 0.02 | 0.07 | 0.02 | 0.00 | 0.00 | 0.03 | 0.01 | 0.20 |
| Dubai | **0.16** | 0.03 | **0.19** | **0.27** | 0.01 | **0.23** | **0.20** | 0.00 |
| Lagos | **0.10** | 0.00 | **0.13** | **0.17** | 0.00 | **0.14** | **0.12** | 0.00 |
| Santiago | 0.02 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

*S*

| Big plants structural glass | Slowness of cleaning | Lack of safety | Environmental impact | Damage on panels | Long downtime | Remaining substances | CAPEX | OPEX |
|---|---|---|---|---|---|---|---|---|
| Trondheim | 0.07 | 0.05 | 0.00 | 0.00 | 0.01 | 0.17 | 0.10 | 0.38 |
| Paris | 0.33 | 0.28 | 0.21 | 0.00 | 0.00 | 0.21 | 0.16 | 0.63 |
| Dubai | **1.82** | 0.30 | **1.51** | **1.06** | 0.10 | **1.62** | **1.42** | 0.00 |
| Lagos | **1.23** | 0.00 | **1.05** | **0.60** | 0.00 | **1.01** | **0.90** | 0.00 |
| Santiago | 0.28 | 0.00 | 0.52 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 |

*F*

| Big plants float glass | Slowness of cleaning | Lack of safety | Environmental impact | Damage on panels | Long downtime | Remaining substances | CAPEX | OPEX |
|---|---|---|---|---|---|---|---|---|
| Trondheim | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.11 | 0.03 | 0.27 |
| Paris | 0.00 | 0.12 | 0.06 | 0.00 | 0.00 | 0.07 | 0.00 | 0.41 |
| Dubai | **0.57** | 0.02 | **1.25** | **2.01** | 0.00 | **1.32** | **1.14** | 0.00 |
| Lagos | 0.28 | 0.00 | **0.81** | **1.25** | 0.00 | **0.75** | **0.65** | 0.00 |
| Santiago | 0.00 | 0.00 | 0.23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| Small plants structural glass | Slowness of cleaning | Lack of safety | Environmental impact | Damage on panels | Long downtime | Remaining substances | CAPEX | OPEX |
|---|---|---|---|---|---|---|---|---|
| Trondheim | 0.00 | 0.17 | 0.00 | 0.00 | 0.00 | 0.31 | 0.05 | 1.61 |
| Paris | 0.01 | 0.54 | 0.00 | 0.00 | 0.00 | 0.16 | 0.04 | 1.34 |
| Dubai | 0.15 | 0.09 | 0.21 | **0.43** | 0.00 | **0.47** | **0.39** | 0.00 |
| Lagos | 0.11 | 0.00 | 0.16 | **0.29** | 0.00 | **0.32** | **0.26** | 0.00 |
| Santiago | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| Small plants float glass | Slowness of cleaning | Lack of safety | Environmental impact | Damage on panels | Long downtime | Remaining substances | CAPEX | OPEX |
|---|---|---|---|---|---|---|---|---|
| Trondheim | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 1.13 |
| Paris | 0.00 | 0.19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.85 |
| Dubai | 0.00 | 0.00 | 0.13 | **0.84** | 0.00 | **0.33** | **0.27** | 0.00 |
| Lagos | 0.00 | 0.00 | 0.07 | **0.64** | 0.00 | 0.17 | 0.12 | 0.00 |
| Santiago | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## Analysis and justification of value buckets

While deepening with ***SpecificUser**$_i$* **value bucket matrices** reveal that the value buckets only concern big plants.

For float glass, the damage on panels is the most important value bucket, whereas it is the less important for structural glass.

Last, Dubai corresponds to higher value buckets. This is due to the nature of hard soiling with cementation (sand and humidity) in the desert. Even if Lagos needs frequent cleaning, the nature of soiling is different and less problematic. This is why it is decided to mainly focus on Dubai conditions during the coming creativity sessions.

# 108 Setting an ambition perimeter

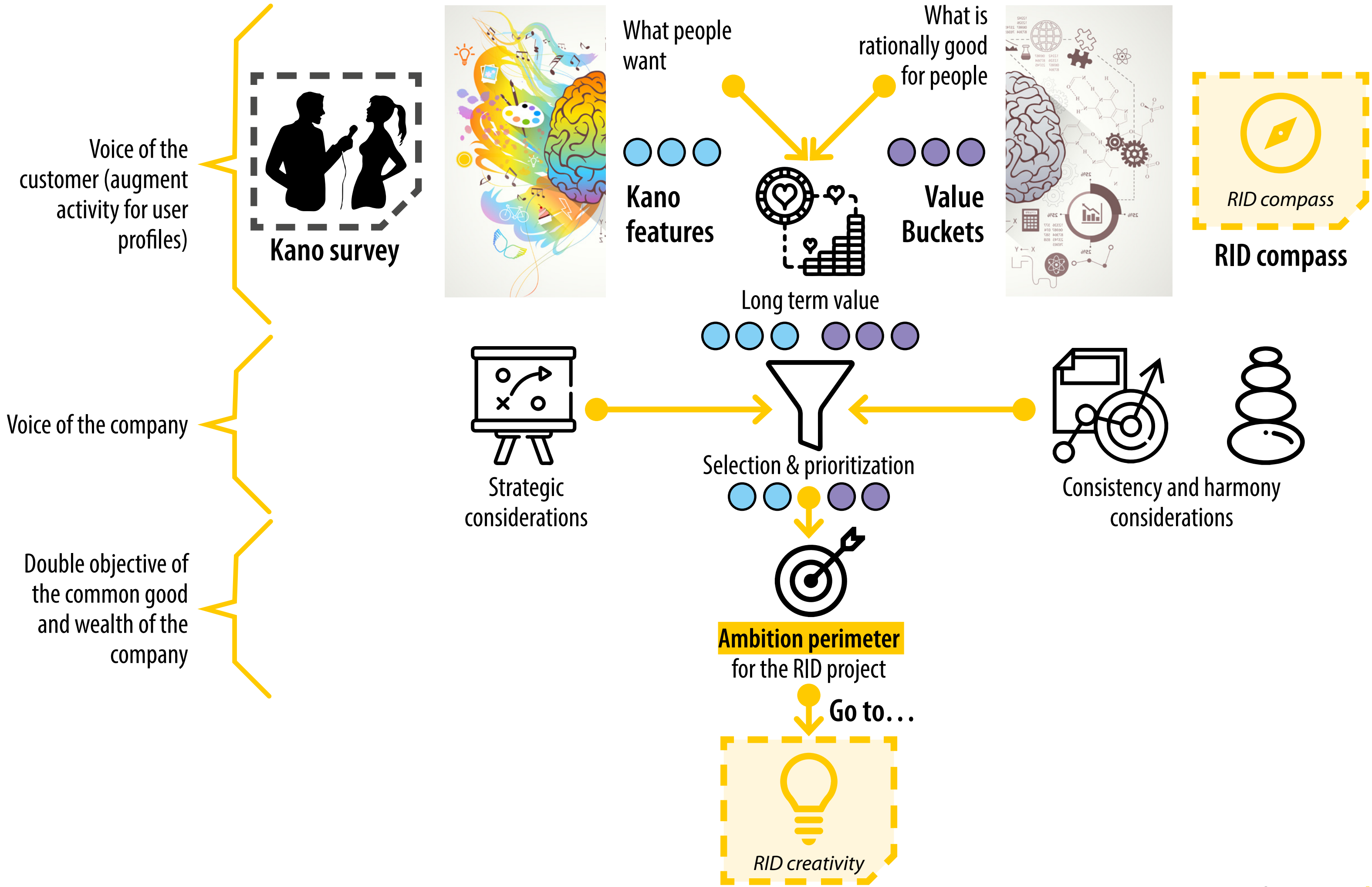
An **ambition perimeter** expresses the necessary compromise between:

1. **What is rationally good for people** (expressed by prioritized macro value buckets outcoming from **RID compass** algorithms and analysis),
2. **What people want** (resulting from a **Kano Analysis**) and
3. **The voice of the company**.

This triplet guarantees after RID theory a **long-term value creation.** The **ambition perimeter** advantageoulsy replaces the traditional marketing or innovation brief, being built on activity data, RID decision algorithms and traceable justifications.

The Voice of the company part is the first moment when the company expresses its preferences and constraints for the continuation of the innovation project. It is made of:

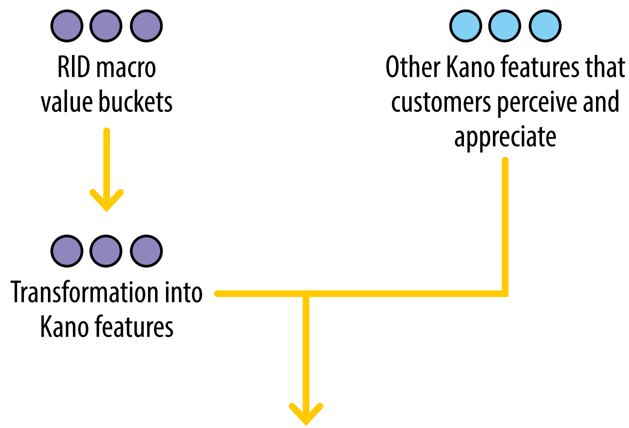
- **Strategic considerations** (core competencies, brand image, expected benefits, technological and market road-maps, easiness to develop…)
- **Consistency and harmony considerations** between the selected value buckets and possible Kano features.


Voice of the customer (augment activity for user profiles)
Kano survey
What people want
Kano features
What is rationally good for people
Value Buckets
RID compass
RID compass
Long term value
Voice of the company
Strategic considerations
Selection & prioritization
Consistency and harmony considerations
Double objective of the common good and wealth of the company
Ambition perimeter
for the RID project
Go to...
RID creativity

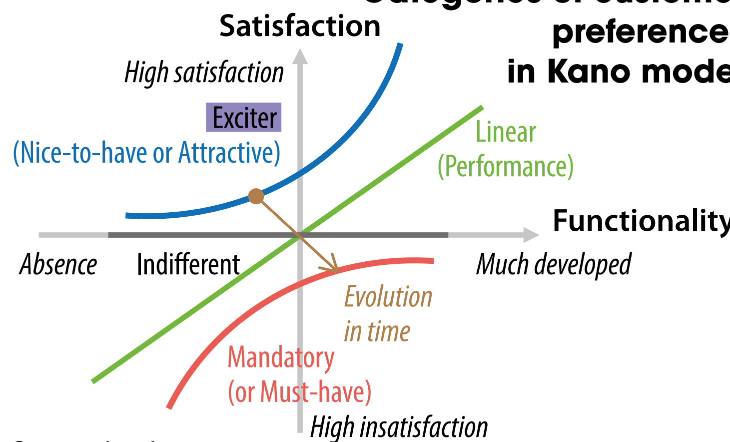
# 109 Kano model and Kano survey

The **Kano model** relates a **perceived attribute** of product or a **service performance** (named a **Kano feature**) to a **category of customer satisfaction**. These categories derive from the fact that the presence or absence of a Kano attribute is **not symmetrical** with consumer satisfaction or dissatisfaction. Different combinations exist, resulting in 6 categories. Kano features in the "nice to have" category tend to evolve towards the "must have" category after a period that corresponds to a market habituation period.

The **Kano survey process within a RID study** involves interviewing around thirty people covering the **user profiles** of the RID study. First, the **RID compass** analysis is performed. Then, the **value buckets** are transformed into Kano features, to which may be added other **Kano features** appreciated by users at the present time (and therefore probably more expressed in terms of solutions). Each respondent answers 2 questions for each Kano feature: **a functional question and a dysfunctional question**. These two questions allow us to find the category among 6 for a given Kano-feature/respondent. The answers of all respondents enable us to apprehend the distribution of user perceptions for each Kano feature.




**Categories of customer preferences in Kano model**




## Functional and dysfunctional questions

| How do you feel if this feature is PRESENT? | How do you feel if this feature is ABSENT? |
|---|---|
| I like it this way | I like it this way |
| I expect it this way | I expect it this way |
| I am neutral | I am neutral |
| I can live with it this way | I can live with it this way |
| I dislike it this way | I dislike it this way |

## Categorization

| Customer requirements | | Dysfunctional question | | | | |
|---|---|---|---|---|---|---|
| | | Like | Expect | Neutral | Live with | Dislike |
| Functional question | Like | Q | E | E | E | L |
| | Expect | R | I | I | I | M |
| | Neutral | R | I | I | I | M |
| | Live with | R | I | I | I | M |
| | Dislike | R | R | R | R | Q |

**M**: Must-have, **L**: Linear, **E: Exciter**, **R**: Reverse, **Q**: Questionable, **I**: Indifferent

*SOURCE*

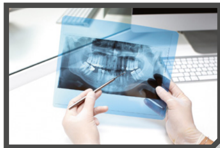
Hou T., Yannou B., Leroy Y., Poirson E., 2019. Mining changes of user expectations over time from online reviews. *Journal of Mechanical Design*, 141 (9).
Matzler K., Hinterhuber H.H., 1998. How to make product development projects more successful by integrating Kano's model of customer satisfaction into quality function deployment. *Technovation*, 18, 25-38.

# 110 Comparison between Kano and RID ratings

The **ambition perimeter** is determined mainly by **comparing the Kano and RID ratings** (before taking the voice of the company into account).

RID proposes **heuristics** to choose items in the ambition perimeter. Indeed, RID theory recommends to:

1. take all the **"mandatory" (or must-have) features** with high value bucket ratings,
2. also consider the **"linear" features** if possible,
3. take **at least one "exciter" (or nice-to-have) feature** with a reasonable value bucket score so as to be in a Blue Ocean.

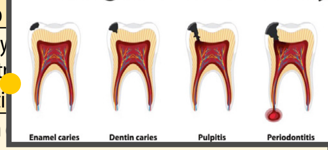


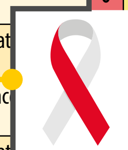
## The 3D dental imagery RID study

| | Kano features | Mandatory | Linear | Exciter | Questionable | Reverse | Indifferent | RID VB score |
|---|---|---|---|---|---|---|---|---|
| Early caries | Have a higher degree of sensitivity than existing diagnosis methods used to detect early caries | 2 | 0 | 3 | 2 | 0 | 6 | 5.40 |
| | Have a higher ability to locate precisely early caries than existing diagnosis methods | 1 | 0 | 4 | 1 | 0 | 7 | 13.60 |
| Periodontitis | Have a higher ability than existing diagn[illegible] periodontitis, in addition to its ability to [illegible] | 1 | 1 | 2 | 1 | 0 | 8 | 4.92 |
| | Have a higher ability to be used on every [illegible] people, children, people with x-ray contr[illegible] | 1 | 0 | 1 | 1 | 0 | 10 | 1.86 |
| Early oral cancer | Reduce the cost of diagnosing and treati[illegible] | 0 | 3 | 3 | 2 | 0 | 5 | 3.18 |
| | Have a higher degree of sensitivity than [illegible] early oral cancer | 0 | 3 | 4 | 1 | 0 | 5 | 5.68 |
| | Have a higher ability to locate precisely early oral cancer than existing diagnosis methods | 0 | 2 | 4 | 1 | 0 | 6 | 5.60 |
| | Have a higher ability to identify early the type and stage of the oral cancer, compared to existing methods | 0 | 2 | 6 | 1 | 0 | 4 | 3.06 |
| | Have a higher ability than existing diagnosis methods to prepare the treat[illegible] early oral cancer, in addition to its ability to diagnose | [illegible] | [illegible] | 3 | 1 | 0 | 7 | 5.28 |
| | Have a higher ability to be used on every individual having early oral canc[illegible] people, children, people with x-ray contra-indication) | [illegible] | [illegible] | 2 | 1 | 1 | 8 | 1.64 |
| Advanced oral cancer | Reduce the cost of diagnosing and treating advanced oral cancer (for the pat[illegible] | [illegible] | 2 | 3 | 1 | 0 | 6 | 1.50 |
| | Have a higher ability to be used on every individual having advanced oral cancer (elder people, children, people with x-ray contra-indication) | 0 | 1 | 3 | 1 | 0 | 8 | 0.80 |
| | Reduce the cost of diagnosing and treating orafacial birth defect (for the patient) | 0 | 3 | 2 | 2 | 0 | 6 | 2.34 |
| | Reduce the cost of diagnosing and treating oral trauma (for the patient) | 0 | 1 | 3 | 1 | 1 | 7 | 0.99 |

**Ambition perimeter**

**The stages of tooth decay**



## The innovative trunk RID study

RID macro value buckets

Transformation into Kano features

Other Kano features that customers perceive and appreciate

| Kano features | Mandatory | Linear | Exciter | Questionable | Reverse | Indifferent |
|---|---|---|---|---|---|---|
| **Increase trunk volume when going on vacation** | 6 | 6 | **20** | 0 | 0 | **13** |
| **Maintain one or two elements in the trunk while driving** | 4 | 5 | **16** | 0 | 2 | **18** |
| **Maintain groceries in the trunk while driving** | 2 | 4 | **23** | 1 | 1 | **14** |
| Increase the volume of the trunk while going shopping | 1 | 2 | 14 | 0 | 2 | 26 |
| Increase the volume of the trunk in order to. . . | 1 | 1 | 8 | 1 | 1 | 33 |
| Ease the trunk cleaning after transporting pets | 3 | 11 | 12 | 2 | 0 | 17 |

**Categorization table of Kano features**

**Ambition perimeter**

| | RID Value Buckets and other Kano Features | RID rating | Kano rating |
|---|---|---|---|
| 1 | Increase loading space WHEN going on vacation | 8.88 | 20 Exciter |
| 2 | Organize the trunk WHEN maintaining one or two objects | 7.92 | 18 Indifferent<br>16 Exciter |
| 3 | Organize the trunk WHEN maintaining groceries | 6.96 | 23 Exciter |
| 4 | Increase loading space WHEN going to the supermarket | 6.88 | 26 Indifferent<br>14 Exciter |
| 5 | Increase loading space WHEN transporting objects likely to get the trunk dirty | 6.6 | 33 Indifferent<br>8 Exciter |
| 6 | Clean WHEN transporting objects likely to get the trunk dirty | 4.65 | 17 Indifferent<br>12 Exciter |

*SOURCE*

Kim, C. W., & Mauborgne, R. (2005). *Blue ocean strategy - How to create uncontested market space and make the competition irrelevant.* Boston, USA/MA: Harvard Business School press, ISBN: 978-1-5913-9619-2.

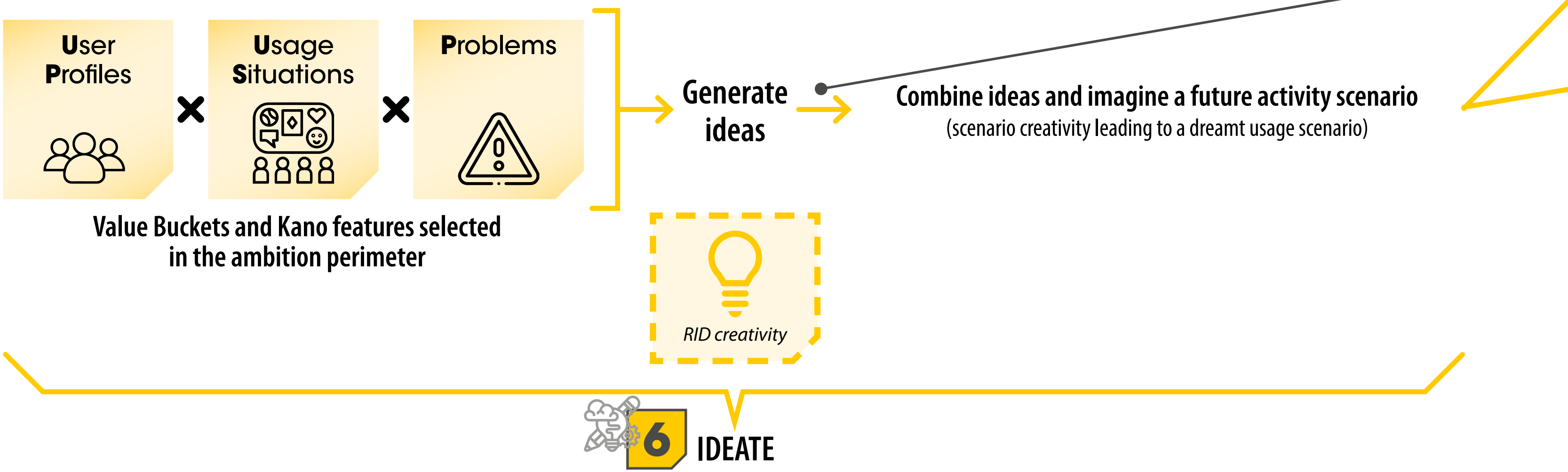
# Chapter 8

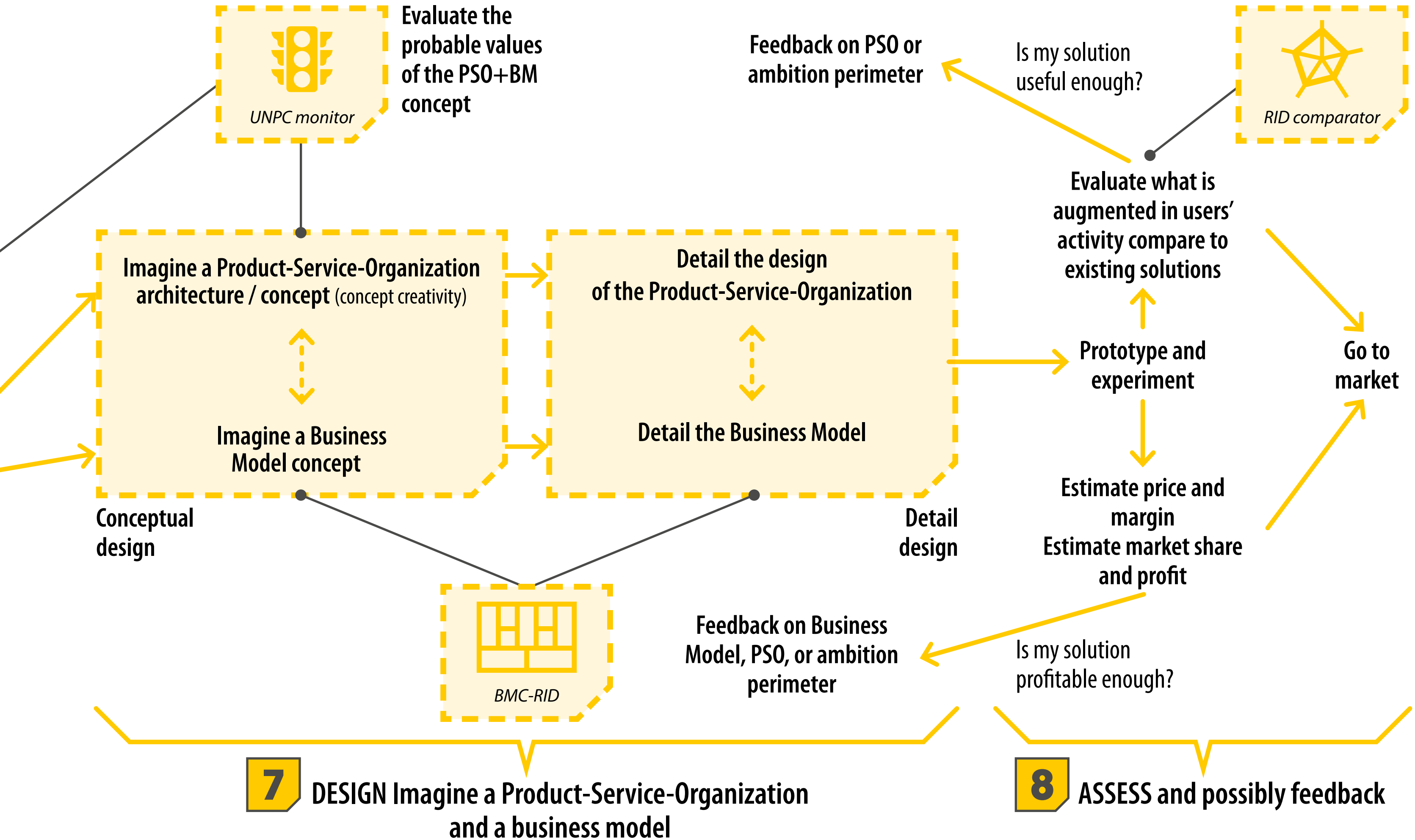
## Solution design

# 111 Zoom on RID problem solving

The **problem solving** part consists in:

- Ideating from the ambition perimeter.
- Designing.
- Assessing, along the two pathways: the Product-Service-Organization's (this is the **solution design sub-process**) and the business model's (this is the **business design sub-process**).





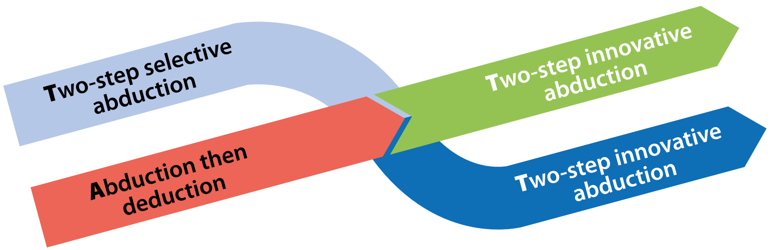
UNPC monitor
Evaluate the probable values of the PSO+BM concept
Feedback on PSO or ambition perimeter
Is my solution useful enough?
RID comparator
Evaluate what is augmented in users' activity compare to existing solutions
Imagine a Product-Service-Organization architecture / concept (concept creativity)
Imagine a Business Model concept
Detail the design of the Product-Service-Organization
Detail the Business Model
Prototype and experiment
Go to market
Conceptual design
Detail design
Estimate price and margin
Estimate market share and profit
BMC-RID
Feedback on Business Model, PSO, or ambition perimeter
Is my solution profitable enough?
7 DESIGN Imagine a Product-Service-Organization and a business model
8 ASSESS and possibly feedback

# 112 Where does ideation stand in RID process?

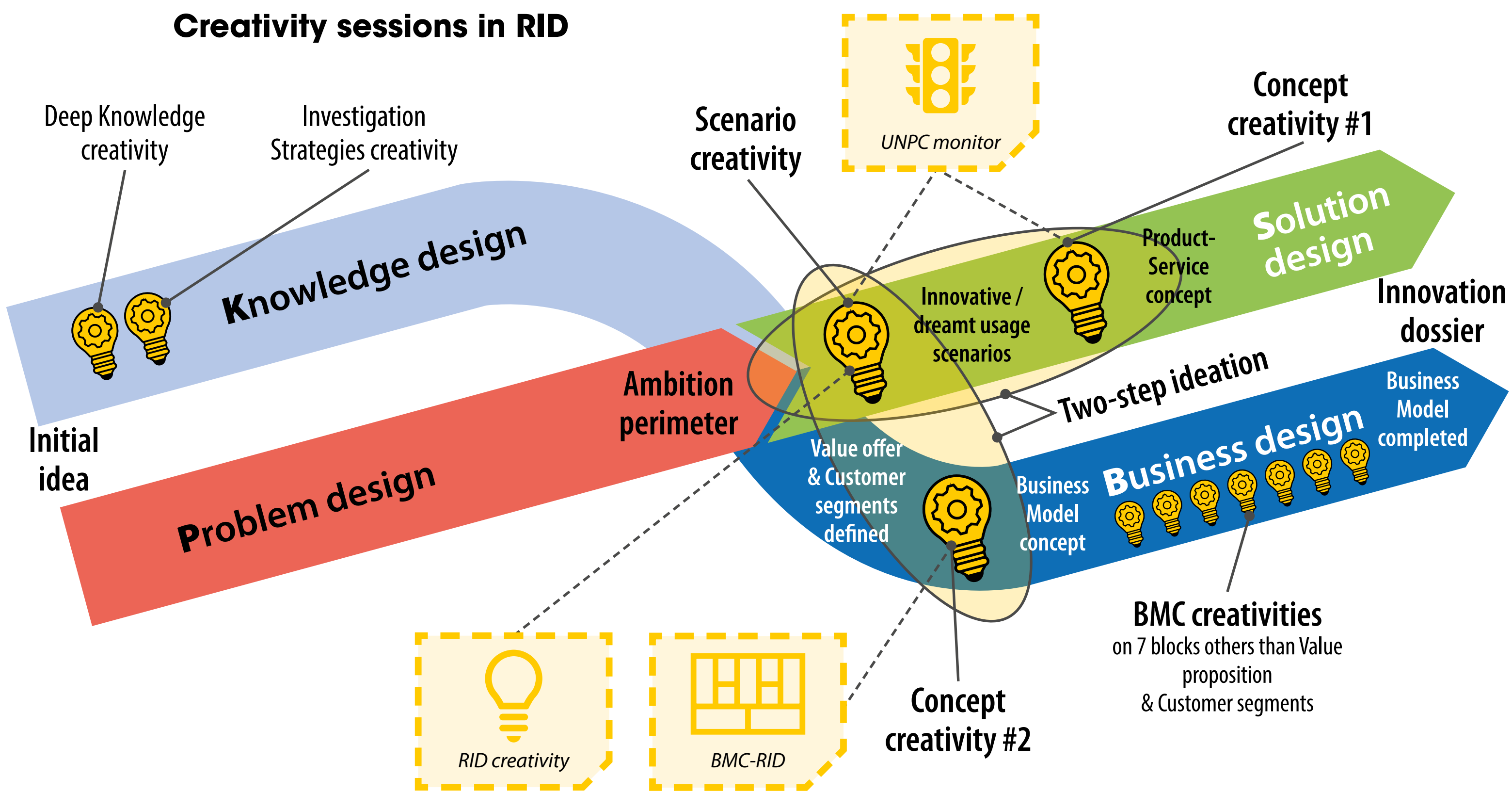
**Ideation** is, by definition, a process of idea generation in which people demonstrate their **creativity**. In RID, ideation processes are localized in a series of well-identified **creativity sessions** throughout the RID process [1]. These **creativity sessions** are all designed to start with specific or **qualified questions** that are relevant and worth asking. Two important creativity sessions take place in series during the **problem-solving** phase, to first ideate the **dreamt usage scenario** during the **scenario creativity**, and secondly the conceptual architecture of the PSO during the **concept creativity**. The distinction between these two sessions is a specific feature of RID, and the notion of the **dreamt usage scenario**, itself evaluated by the UNPC monitor tool, seems to us to be of prime importance.

The ability of the RID process as a whole to make the most of a group's creativity was studied in [1] by mapping the periods of predominant logical reasoning modes in a RID process, according to 4-mode Kroll and Koskela's model: induction, deduction, selective abduction, innovative abduction.

Findings of this study [1] are coherent with what RID claims: a first Problem Setting to capture a rich understanding of the current activity, then a Problem Solving to generate new objects that can improve the activity. These findings also match empirical results which show correlations between the quality of Problem Setting and the quality of Problem Solving [3].




**The dominant logical reasoning modes along RID process [1]**

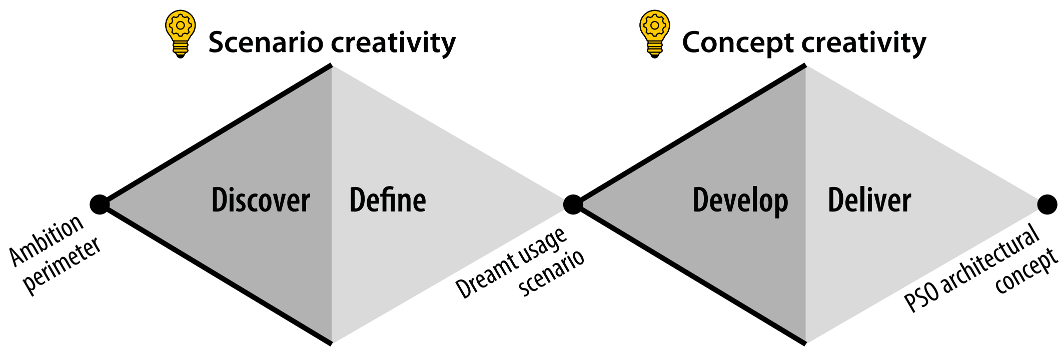



**SOURCE**
[1] Lamé G., Yannou B., Cluzel F., 2018. Analyzing RID methodology through the lens of innovative abduction, *In International Design Conference, May 21-24*, Dubrovnik, Croatia.
[2] Kroll, Ehud, and Lauri Koskela. 2016. "Explicating concepts in reasoning from function to form by two-step innovative abductions." Artificial Intelligence for Engineering Design, Analysis and Manufacturing 30 (2):125-137.
[3] Yannou B., Jankovic M., Leroy Y., Okudan Kremer G.E., 2013. Observations from radical innovation projects considering the company context. Journal of Mechanical Design, 135 (2).

# 113 The two-step ideation of the PSO

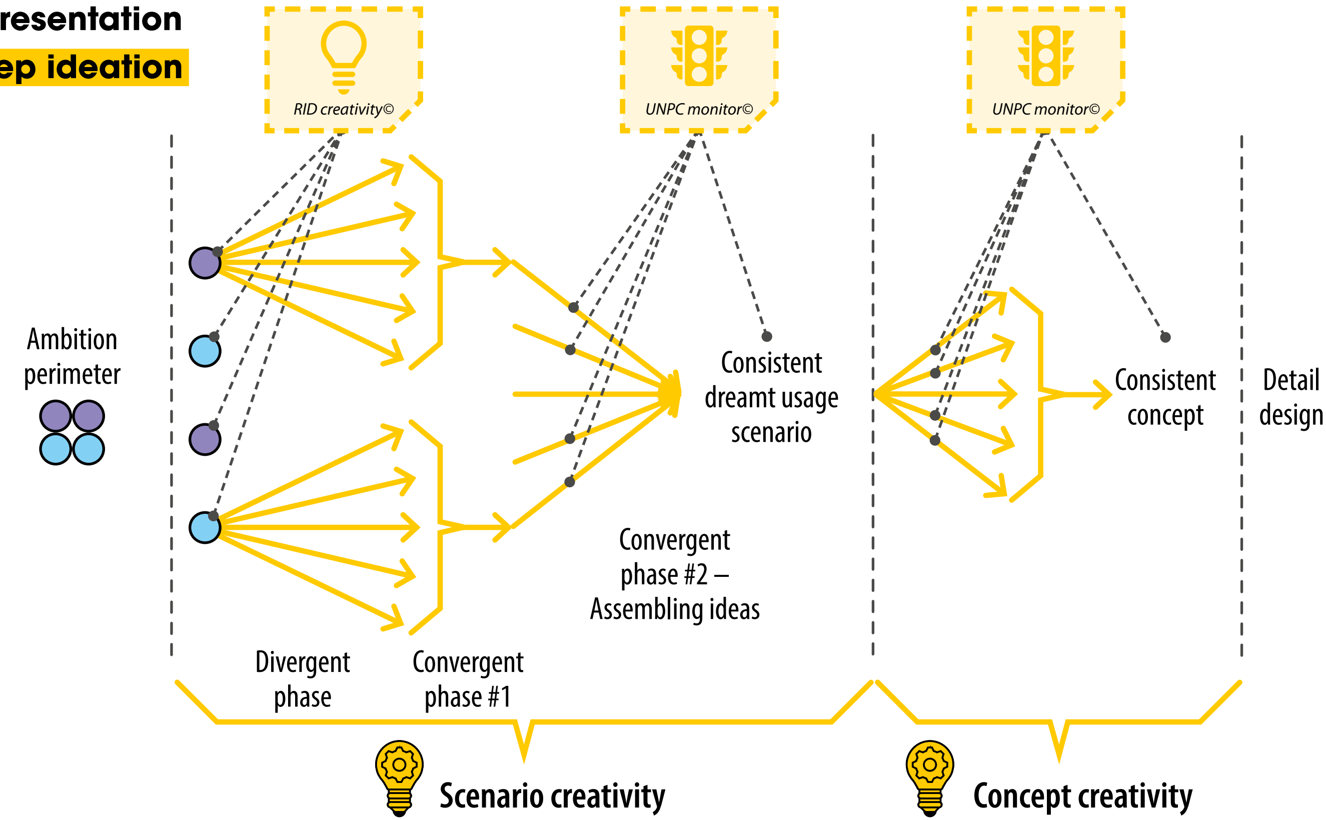
The **two-step ideation of the Product-Service-Organization** (PSO), made of **scenario creativity** and **concept creativity**, takes place at the beginning of the **solution design** sub-process. It is a **double-diamond process** made of four stages:

1. For each macro value bucket and Kano feature selected in the ambition perimeter, as many sets of ideas are generated using the **RID creativity tool**.
2. One or more **dreamt usage scenarios** are sketched out, put in a collection bag, possibly combined and hybridized, and finally evaluated in terms of potential of value creation thanks to **UNPC monitor tool**. A preferred dreamt usage scenario is then selected.
3. From the selected **dreamt usage scenario** a conventional brainstorming session is carried out, leading to ideas which, once filtered out, combined and hybridized, leads to a series of architectural **concepts**.
4. These architectural **concepts** are, in turn, evaluated in terms of potential of value creation thanks to **UNPC monitor tool**. Finally, a preferred PSO architectural concept is selected to continue with **detail design**.




**Double-diamond process**

## Detailed representation of the **two-step ideation of the PSO**




**SOURCE**

Lamé G., Yannou B., Cluzel F., 2018. Analyzing RID methodology through the lens of innovative abduction, *In International Design Conference, May 21-24, Dubrovnik, Croatia.*
Yannou B., Cluzel F., Farel R., 2016. Capturing the relevant problems leading to pain and usage driven innovations: the DSM Value Bucket algorithm. *Concurrent Engineering, 1-16.*

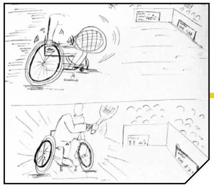
# 114 An example of two-step ideation

## The tennis wheelchair RID study

<u>**Value bucket #1**</u>: *significant delay* **before** *being in position for receiving the ball* **due to** *her right hand grasping the tennis racket and moving the wheel at the same time*

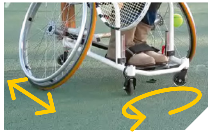
*Does not have a racket in hand when seizing the two hand rims of the chair. Racket "retracts" temporarily.*

*Able to release her right hand holding the racket at any time by allowing the left hand to control the two wheels.*



<u>**Value bucket #2**</u>: *loss of power* **during** *service partly* **due to** *the observed wheelchair twist*

*Emmanuelle positions herself behind the baseline and prepares to serve. She activates a system for blocking the rotation of the two caster wheels. The serve does not provoke any twist but automatically releases the blocking system, allowing her to push the hand rims propelling her on the court.*

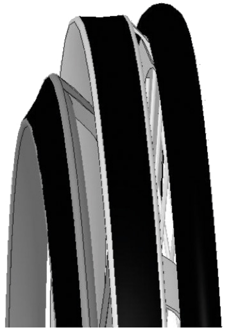


**Ambition perimeter**

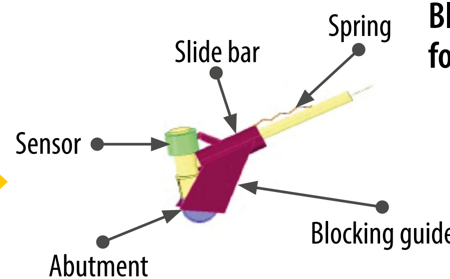
**Dreamt usage scenarios**

**Scenario creativity**

Magic glove for storing racket on back side



Two-rim system for left hand wheel




Blocking fork for caster wheel

## Concept creativity

***SOURCE***
Yannou B., Cluzel F., Farel R., 2016. Capturing the relevant problems leading to pain and usage driven innovations: the DSM Value Bucket algorithm. *Concurrent Engineering - Research And Applications* (CERA), 1-16.

# 115 The RID creativity tool – Principles

*RID creativity*

The **RID creativity tool** is a powerful ideation tool which achieves focused creativity from the **macro value buckets** of the **ambition perimeter**. It is used during **scenario creativity** at the very beginning of the **solution design** sub-process and allows you to explore intensively basic innovative ideas, scenario chunks and concept chunks, aiding for the generation of a preferred **dreamt usage scenario**.

DOWNLOADABLE TEMPLATE

| Macro Value-Bucket: *(put definition here)* | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | **IS** Describe the defective situation | **IS NOT** Describe the **trouble-free situation** | **Distinction contrast** **What** is different, odd, special, or unique about an IS compared to its IS NOT? | **Distinction cause** **Why** the IS is different from the IS NOT? | **Dreamt usage scenario** Regarding the distinction causes, which dreamt usage scenario could be imagined? Which characteristics of the IS NOT could be applied to the IS? | **Conceptual solution** Regarding the dreamt usage scenario, which conceptual solution could be imagined? |
| USER | User profiles | | | | | | |
| | # | | | | | | |
| PROBLEM | Nature (failure mode) | | | | | | |
| | # | | | | | | |
| | Causes | | | | | | |
| | # | | | | | | |
| | Consequences | | | | | | |
| | # | | | | | | |
| | Severity | | | | | | |
| | # | | | | | | |
| | Period | | | | | | |
| | # | | | | | | |
| | Timing | | | | | | |
| | # | | | | | | |
| | Conditions | | | | | | |
| | # | | | | | | |
| | Location | | | | | | |
| | # | | | | | | |
| USAGE SITUATION | Nature | | | | | | |
| | # | | | | | | |
| | Size | | | | | | |
| | # | | | | | | |
| NOWADAYS | Emergence | | | | | | |
| | # | | | | | | |
| | Other satisfactory solutions | | | | | | |
| | # | | | | | | |

The **RID creativity tool** has been adapted using a root cause analysis technique (problem solving and decision making) developed by Kepner Tregoe company and known as IS/IS-NOT. The **RID creativity tool** has been adapted to the value bucket ontology (or decomposition) in order to deviate a defective situation into a trouble-free one. All the information collected about a macro value bucket is exploited by this creativity tool to prompt creative ideas, e.g. problems, their causes and consequences in the causal graph, associated usage situations, coverage of existing solutions.

The method consists of **comparing two situations: a defective and painful situation (the "IS")**, during which a problem or a deviation is noticed, and a **trouble-free situation (the "IS NOT")**, which is not affected by the problem, while still being very similar to the "IS" situation. **Each attribute of the macro value bucket is shifted to imagine the "IS NOT" situations.** The designer can find new solutions by answering the question "which characteristic from "IS NOT" could be applied to the "IS" to tackle the issue?". For this purpose, four questions lead to express the distinction between IS and IS NOT situations:

1. What is different?
2. Why is it different?
3. Regarding the cause of distinction, imagine a dreamt usage scenario
4. Imagine, if possible, a resulting conceptual solution

# 116 The RID creativity tool – Example

RID creativity

The **macro value bucket** studied here is "*Waste of time and other irritants DURING traffic jam*".

Other irritants can easily be imagined as impossibilities to (i) meet a medical need, (ii) satisfy a natural need, (iii) entertain oneself, (iv) work at the office or at home, etc.

Traffic jam example provided

DOWNLOADABLE EXAMPLE

RADICAL INNOVATION DESIGN MICRO TOOL

| **Macro Value-Bucket:** *Waste of time and other irritants DURING traffic jam* | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | **IS** Describe the defective situation | **IS NOT** Describe the **trouble-free situation** | **Distinction contrast** **What** is different, odd, special, or unique about an IS compared to its IS NOT? | **Distinction cause** **Why** the IS is different from the IS NOT? | **Dreamt usage scenario** Regarding the distinction causes, which dreamt usage scenario could be imagined? Which characteristics of the IS NOT could be applied to the IS? | **Conceptual solution** Regarding the dreamt usage scenario, which conceptual solution could be imagined? |
| **USER** | **User profiles** | Who is/are the user(s) concerned by the problem? | Which similar user(s) could be less or not concerned by the problem? | What is different, odd, special, or unique about an IS compared to its IS NOT? | Why the IS is different from the IS NOT? | Regarding the distinctions causes, which dreamt usage scenario could be imagined? Which characteristics of the IS NOT could be applied to the IS? | Regarding the dreamt usage scenario, which conceptual solution could be imagined? |
| | 1 | *Car driver* | *Pedestrian/ Motorcyclist/ Cyclist* | *The user needs to run for long distances* | *His/her destination (work, shopping) is far from home* | *Limit the displacement* | *Tasks digitization + online services* |
| | | | *Public transport user* | *1- The user spends less physical efforts*<br>*2- He has a better protection* | *He/she requires more safety and comfort* | *Improve autonomy and comfort while using a shared transprtation means* | *1- Little scooters available in the public transport station that people can share*<br>*2- Carpooling*<br>*3- SplitBus or SplitTrain modular transportation mean that can be split into several mini-cars* |
| **PROBLEM** | **Nature** (failure mode) | What is/are the problem(s) the user faces? | Which similar problems could vanish? | What is different, odd, special, or unique about an IS compared to its IS NOT? | Why the IS is different from the IS NOT? | Regarding the distinctions causes, which dreamt usage scenario could be imagined? Which characteristics of the IS NOT could be applied to the IS? | Regarding the dreamt usage scenario, which conceptual solution could be imagined? |
| | 1 | *Waste of time: cannot perform neither office tasks (writing, reading, meetings), nor entertainment tasks (books, films, games…)* | *Listening to music, calling, looking around, vocal assistance for GPS* | *Manual tasks versus soft tasks (listening, sight, speaking)* | *His/her hands and sighs are involved in driving tasks* | *Driving tasks automation to allow driver performing other tasks* | *Connected and autonomous car* |
| | | | | *No adapted embedded equipments for office and entertainment tasks* | *No offer on the market* | *Installing adapted equipments for Writing (automatic speech recognition + office apps), Reading (Head-up display and computer-assisted reading), Meeting (camera and phone), Entertainment (new games that involves only soft capacities voice and sighs)* | *1- Connected vehicle*<br>*2- CarOffice package* |
| | 2 | *Waste of time: cannot perform manual home tasks (hair dressing, …)* | *Manual driving tasks* | *Home tasks are secondary task* | *Driving is the main task* | *Driving tasks automation to allow driver performing other tasks* | *Connected and autonomous car* |
| | 3 | *Medical need: passengers don't have their medication in the car* | *Passengers have their medication in the car* | *Taking medication is possible* | *There is no storage space and people don't think to take medecines in their car* | *An intelligent car which plan which medecines you must take and where to store them* | *Connected car equipped to store medecines* |
| | 4 | *Natural need: to go to the bathroom* | *Take a shower and go to toilets* | *Natural need versus hygiene need* | *Going to bathroom cannot be delayed* | *Allowing the driver to satisfy his/her natural need in the car* | *Toilets in the car* |

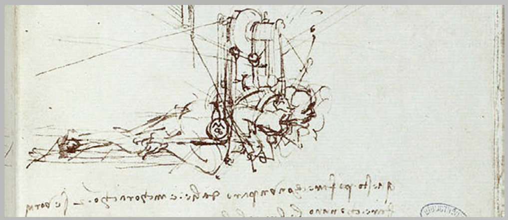
# 117 Dreamt usage scenario

A **dreamt usage scenario** is a usage scenario of the **future desired activity** where the desired effects are illustrated in narrative form, without describing the entire solution. The dreamt usage scenario is like a **fairy tale**, where there is a happy ending without any problem during the activity. In RID, dreamt usage scenarios are produced in the **scenario creativity** stage at the beginning of the **solution design** sub-process.

**Some advice for a good description of a dreamt usage scenario:**

- Be ambitious when dreaming
- Do not talk about the solution, nor describe its actions too precisely
- It is better to describe the universe in which the solution will exist and how this universe harmoniously evolves to achieve the activity
- Describe the atmosphere
- You might already be able to segment customers and set a price

**Leonardo da Vinci** wrote about how a pilot of a glider machine with nacelle could feel, moving himself in a nacelle to the right or to the left so as to move the center of gravity, then tilting the wing to the side of the displacement. He imagined how we could drive a hang-glider by using our knowledge of the pendulum equilibrium principle.



## Dreamt usage scenario corresponding to activity "becoming bored in a retirement home"

While the elderly can no longer bend down to garden, a piece of the garden could be brought up to the right height, and the elderly could then garden alone or in groups, sitting or standing

The elderly could proudly show their little garden to their grandchildren and even share this activity with them. An elderly person could also start a horticultural club and give gardening lessons to other people in the retirement home or to others in the community.

When winter arrives, the elderly will be able to continue their passion by bringing their gardens into their heated homes.

**Steve Jobs speaking of the revolutionary user interface of the first iPhone at MacWorld 2007:** *"So let's not use a stylus. We're going to use the best pointing device in the world. We're going to use a pointing device that we're all born with - born with ten of them. We're going to use our fingers. We're going to touch this with our fingers. And we have invented a new technology called multi-touch, which is phenomenal. It works like magic."*

VIDEO LINK

## The AutoNOM RID study

VIDEO LINK

Video illustration (stop motion technique) of existing usage scenarios

Innovative design

VIDEO LINK

Video illustration (stop motion technique) of a dreamt usage scenario

# 118 Scenario creativity

**Scenario creativity** is an ideation stage during the solution design sub-process. Starting from selected macro value buckets and Kano features of an ambition perimeter, it results in one or more dreamt usage scenarios (see also two-step ideation).

## Detailed process of scenario creativity – Example of Accesseat RID study

**1** Consider **macro Value Buckets (VB)** of the **ambition perimeter**

**2** For each VB, brainstorm (divergent phase), generate and classify ideas in an **idea space collector**

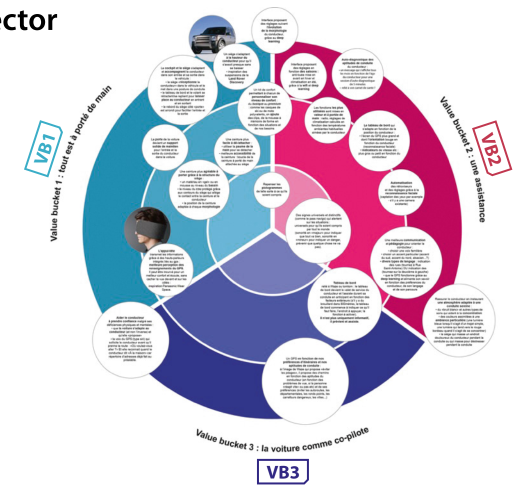
| | Tiredness | Visibility | Physical pain | Movement restrictions | Lack of attention | Discomfort | Anxiety | Memory |
|---|---|---|---|---|---|---|---|---|
| Sitting down | 4 | 0 | 15 | 20 | 0 | 9 | 4 | 0 |
| Putting and removing seat belt | 4 | 0 | 15 | 16 | 0 | 9 | 0 | 0 |
| Wearing the seat belt | 0 | 0 | 15 | 0 | 0 | 12 | 8 | 0 |
| Deposition of personal things | 0 | 0 | 9 | 7,2 | 0 | 5,4 | 9,6 | 0 |
| Adjusting the seat | 0 | 0 | 6 | 8 | 0 | 3,6 | 0 | 4 |
| Adjusting the mirrors | 0 | 3,6 | 0 | 2,4 | 9,6 | 0 | 2,4 | 6 |
| Adjusting the steering wheel | 0 | 1,2 | 0 | 0 | 0 | 0,6 | 0 | 3 |
| Adjusting of the center console | 0 | 7,2 | 4 | 0 | 16 | 4,8 | 12,8 | 16 |
| Adjusting at steering wheel level | 0 | 9 | 0 | 0 | 12 | 0 | 0 | 15 |
| Reacting in critical situations | 1,6 | 0 | 4 | 0 | 8 | 2,4 | 6,4 | 8 |
| Driving on a long journey | 8 | 4,8 | 10 | 1,6 | 8 | 6 | 8 | 0 |
| Driving on a road in poor conditions | 8 | 2,4 | 4 | 1,6 | 6,4 | 4,8 | 8 | 0 |
| Driving on a fast road | 3,2 | 2,4 | 2 | 0 | 3,2 | 1,8 | 4 | 1 |
| Driving against the light | 7,2 | 9 | 3 | 0 | 7,2 | 3,6 | 7,2 | 0 |
| Reaction at an intersection | 6,4 | 7,2 | 0 | 12,8 | 16 | 4,8 | 12,8 | 4 |
| Maneuver to park within the city | 7,2 | 7,2 | 6 | 7,2 | 2,4 | 5,4 | 12 | 3 |
| Getting out of the vehicle | 4 | 0 | 20 | 20 | 0 | 12 | 4 | 0 |

Only driver affected

VB1

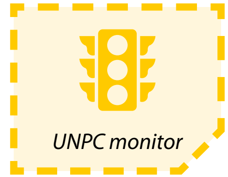
VB2

VB3



**3** For each VB, narrate a story for the set of ideas. These stories are **elementary dreamt usage scenarios**.

**4** Assemble these stories into **one or several coherent dreamt usage scenarios**. Evaluate its potential of value creation thanks to **UNPC monitor tool**.




## VB1 The Valet

*To create a comfortable and safe user experience from installation to uninstallation with the aid of inflatable cushions. A valet opens the door for you as you approach. He/she is considerate: by guessing your intention to sit down he/she will move the seat forward for you, and you will be able to let yourself sit down without worrying and without significant effort.*

## VB2 The Servant

*To support the driving skills of the elderly driver during the whole car journey with the aid of…*

## VB3 The Co-Pilot

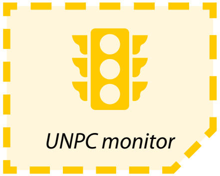
*To support the elderly driver at intersections and maneuvers while leaving him/her in control with…*

# 119 Concept creativity

**Concept creativity** is an ideation stage during the **solution design** sub-process. Starting from a **dreamt usage scenario**, it results in one or more conceptual design solutions (see also **two-step ideation**).

**Detailed process of concept creativity:**

1. Starting from a dreamt usage scenario, organize a creativity session.
2. Assemble your ideas into one or more coherent product-service-organization (PSO) architectural concepts.
3. Illustrate the architectural concept(s) and the usage situations for which usage has been improved.
   Go as far as simulating the "gains" on the selected macro value buckets.
4. Evaluate its potential of value creation thanks to UNPC monitor tool.



## Example of Accesseat RID study concept creativity

### VB1 The Valet dreamt usage scenario

*"To create a comfortable and safe user experience from installation to uninstallation with the aid of inflatable cushions"*

**1**

Pneumatic parts are integrated into the existing structure
→ Adapt the height of specific area when getting into and out of the car

**3**

During the car journey, the seat reverts to its original state (non-inflated).

**2**

During the process of installation, pneumatic parts automatically adjust
→ Allows easy entry into the car
→ Driver's movements are more fluid

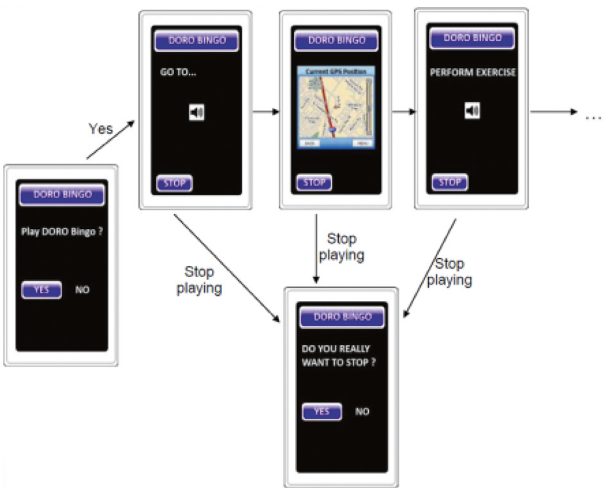
**4**

The back of the seat repositions the driver/passenger to facilitate the entry into the car
→ Lightly inclines the back and and leg to minimize the effort required to get out

# 120 Concept or architecture

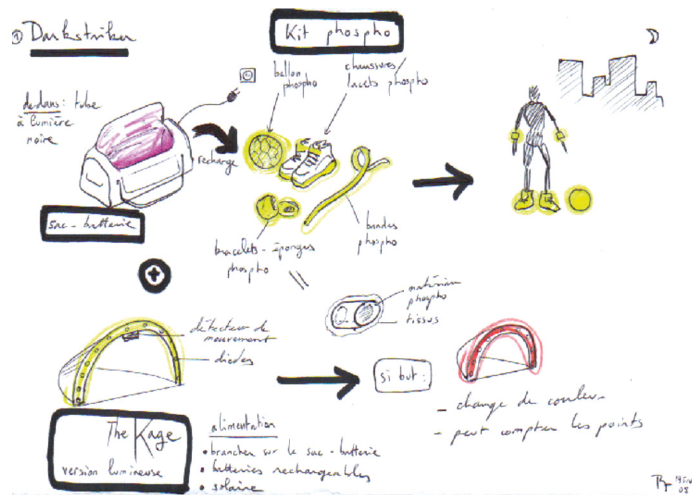
A **conceptual or architectural solution** is a **schematic diagram** of a **product-service-organization** solution. This is an **architecture** or **structure** generally defined by assembling a number of **subsystems** or **components** into temporary or permanent **links**. These subsystems may be material or abstract like processes, software, human-machine interfaces.

## An "app" conceptual solution




## A concept may also be annotated

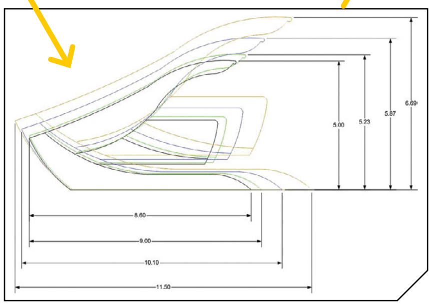
The annotations can concern: usage situations, services, contexts, functions, users, interactions, operations, tasks, processes, performances, storytelling…



## From problem setting to real solution

**Ideal Goal + Ambition Perimeter**
(requirements specifications)

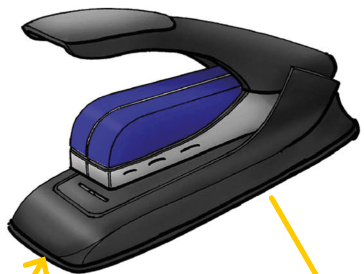
Creativity
Exploration of patents, design principles, storytelling, system design, kinematic and architectural structures



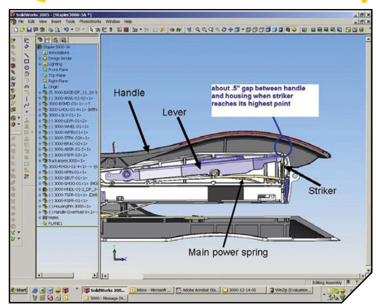

**Dreamt Usage scenario + Conceptual solution /**
concept / architecture

Global sizing of parts, shapes, colors, masses, tolerances, mechanical properties

**Embodiment design /**
Pre-dimensioning



Precise shapes, materials, make or buy decisions, simulations (deformations, constraints, manufacturing processes, assembly)




**Detail design**

Prototypes and tests, process engineering

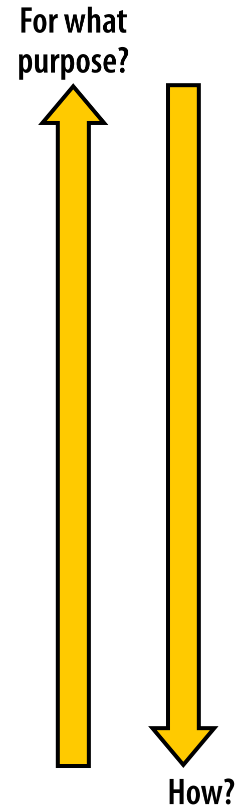
**Prototype and series**

# 121 The activity-based process for prototyping and experimenting in RID

For RID, innovative design is considered within the framework of the transformation of a user's **activity system**. **Prototyping** is then a means to **experiment** that the innovative PSO solution imagined effectively performs as expected. This is why the prototype must be designed for allowing the experimentation to demonstrate that the **targeted value buckets** are effectively lessened, and the **activity positively augmented** as expected.

## Traceability

1. We **want to improve or develop new activities/usage** because: (a) current activities are not perfect, (b) we have new needs, (c) the world and our lives are changing
2. A **new PSO solution** (value offer) is **designed** for **new activities/usage** and **chosen** among candidates
3. We must **validate** the **most challenging performances** of the design, and especially the **targeted value buckets of the ambition perimeter** so as to **"augment the activity"**
4. We **experiment** to validate these most challenging performances
5. We **prototype** to experiment



### Example of the lunar motorbike

1. We want to ***enable fast and safe individual travel on the lunar*** *surface* because we have **decided** to explore the moon
2. An **electric motorbike** (value proposition) is **designed** for this new activity/use
3. We must **validate** the most difficult performances and targeted value buckets, for instance **stability during acceleration, driving and braking**
4. We **experiment** in a (most similar conditions) **gravity ballistic aircraft with a suit** to validate
5. We **prototype** a **minimal electric motorbike and tie-down straps** to experiment with


**Legend:**
**Action verb**
**Element to design**

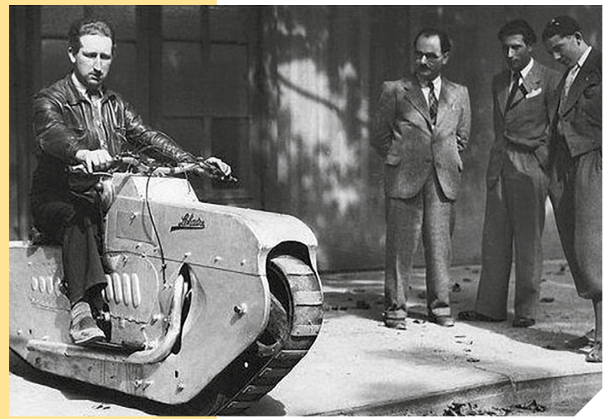
# 122 Minimum Viable Prototype

Eric Ries defined the notion of a **Minimum Viable Product**. In RID, we adapt this definition in the one of the **Minimum Viable Prototype**.

In RID, a **Minimum Viable Prototype** is that version of a new product-service-organization AND business model solution which allows a team to collect the maximum amount of validated learning about customers with the least effort. This validated learning comes in the form of whether your customers will actually use your solution to practice their activity, while lessening the selected value buckets.

1. **You produce an actual prototype** which may be no more than a landing page, or a service with an appearance of automation, but which is fully manual behind the scenes.
2. **You offer it to the user profiles involved of your activity and observe their actual behavior** with the PSO solution to check if their activity has been augmented. Seeing what people actually do with respect to a product is much more reliable than asking people what they would do.
3. It is in a **posterior stage** that you will try to refine PSO & BM solution and prove with a Minimum Viable Product **whether your customers will actually purchase** your product.

Note that in Lean Startup, a Minimum Viable Product directly serves to assess if customers will purchase your solution, whereas in RID a **Minimum Viable Prototype** evaluates first whether your user profiles will actually use your solution.

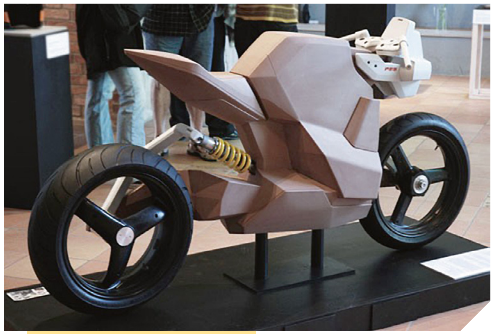


**Prototype "Lehaître" for a tracked caterpillar motorcycle (1938)**

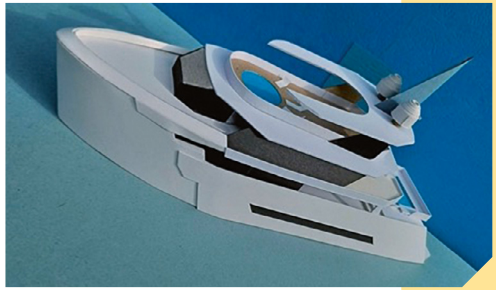
*SOURCE*
Ries, E. (2011). *The Lean Startup*. New-York: Crown Business, ISBN: 978-0-3078-8789-4.

# 123 Physical prototyping techniques

Some simple **prototyping techniques**

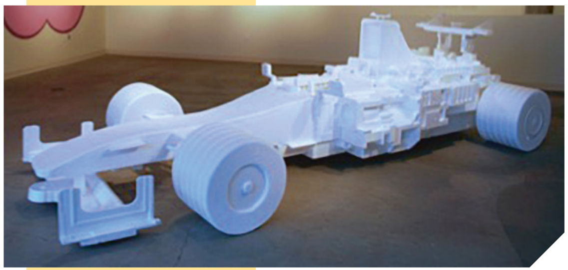


Polyurethane foam

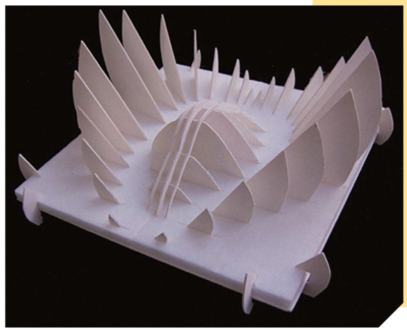


Paper craft

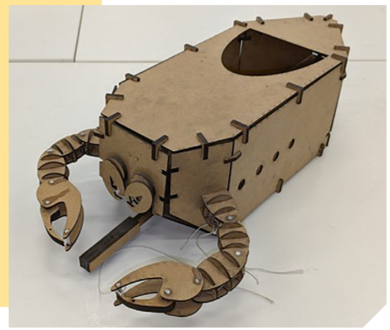
Cardboard



Styrofoam



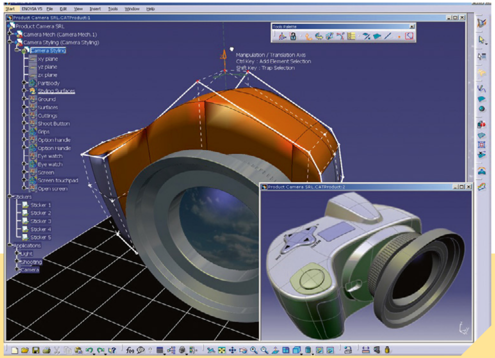
Polystyrene foam core



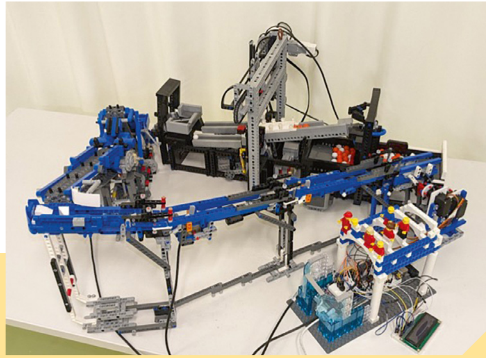
Wood

## Some more sophisticated prototyping techniques

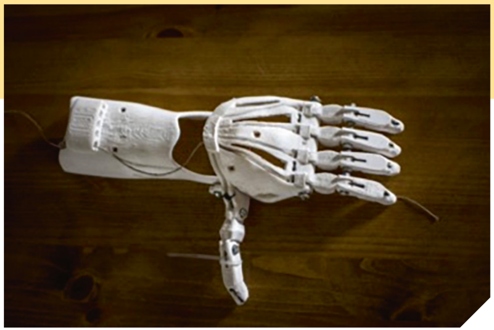
3D CAD (Computer Aided Design)



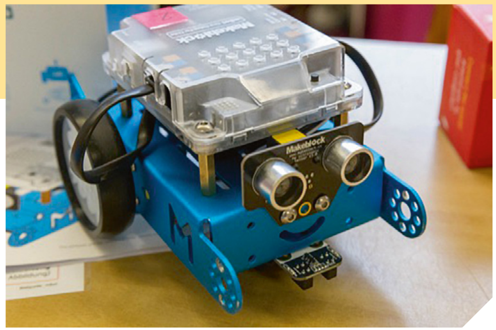
Lego® technic



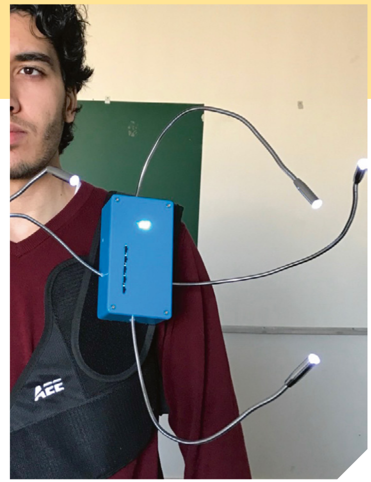
Augmented reality:
The Digiscope project (SINAPSE)



Additive manufacturing



Arduino



Functional prototype

# 124 The solution design sub-process – Example

**User Profiles**
S
F

×

**Usage Situations**
*Dubai*
*Lagos*

×

1 Damage on panels

2 Remaining substances

3 CAPEX

4 Environmental impact

5 Slowness of cleaning

**Ambition perimeter**

**Idea generation**

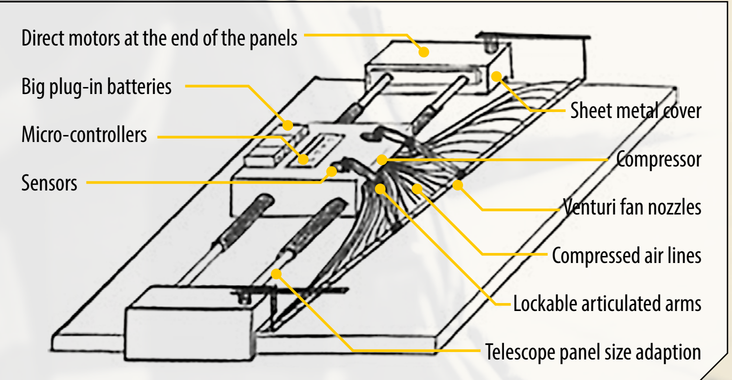
*RID creativity*

## Cleaning solar panels RID study

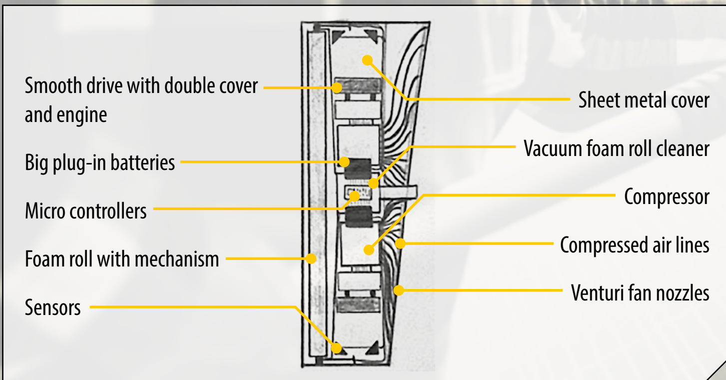
### Dreamt usage scenario

*"The solar panels produce renewable energy all through the year, in a sunny and hot location like Dubai. Panels are cleaned by a gentle gust of wind that removes the dust blanket. Wind waits for orders: when power output sensors identify a decrease in electricity production, then the wind starts blowing. The breeze also cools down the panels, Dubai is such a scorching place! Remotely, the solar farm manager can easily monitor and plan the cleaning operations throughout the year, in fact the dashboard is updated live."*

**Scenario creativity**




Solution #1: Nozzle System




Solution #2: Modular System

**Concept creativity: 2 architectural solutions**

## Evaluation of value creation potential

*UNPC monitor*

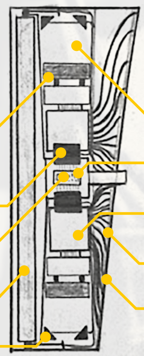
| | Solution 1 Impact [−1; 1] | Solution 1 Certainty [−1; 1] | Solution 1 Impact [−1; 1] | Solution 1 Certainty [−1; 1] |
|---|---|---|---|---|
| **Usefulness** | 0.60 | 0.85 | 0.80 | 0.85 |
| **Newness** | 0.60 | 0.80 | 0.60 | 0.70 |
| **Profitability** | 0.60 | 0.85 | 0.50 | 0.75 |
| **Concept** | 0.40 | 0.60 | 0.55 | 0.70 |

Continued on next page…

# 124 The solution design sub-process – Example

**(…) continued from previous page**

**Product: Modular System** (solution #2)



Smooth drive with double cover and engine

Big plug-in batteries

Micro controllers

Foam roll with mechanism

Sensors

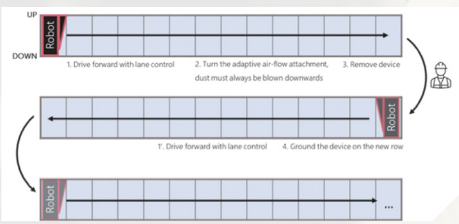
Sheet metal cover

Vacuum foam roll cleaner

Compressor

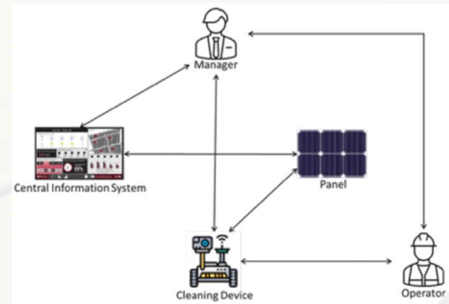
Compressed air lines

Venturi fan nozzles




**Services / Processes**
Installation/ dismantling of cleaning device, Manual operations, Maintenance, Storage

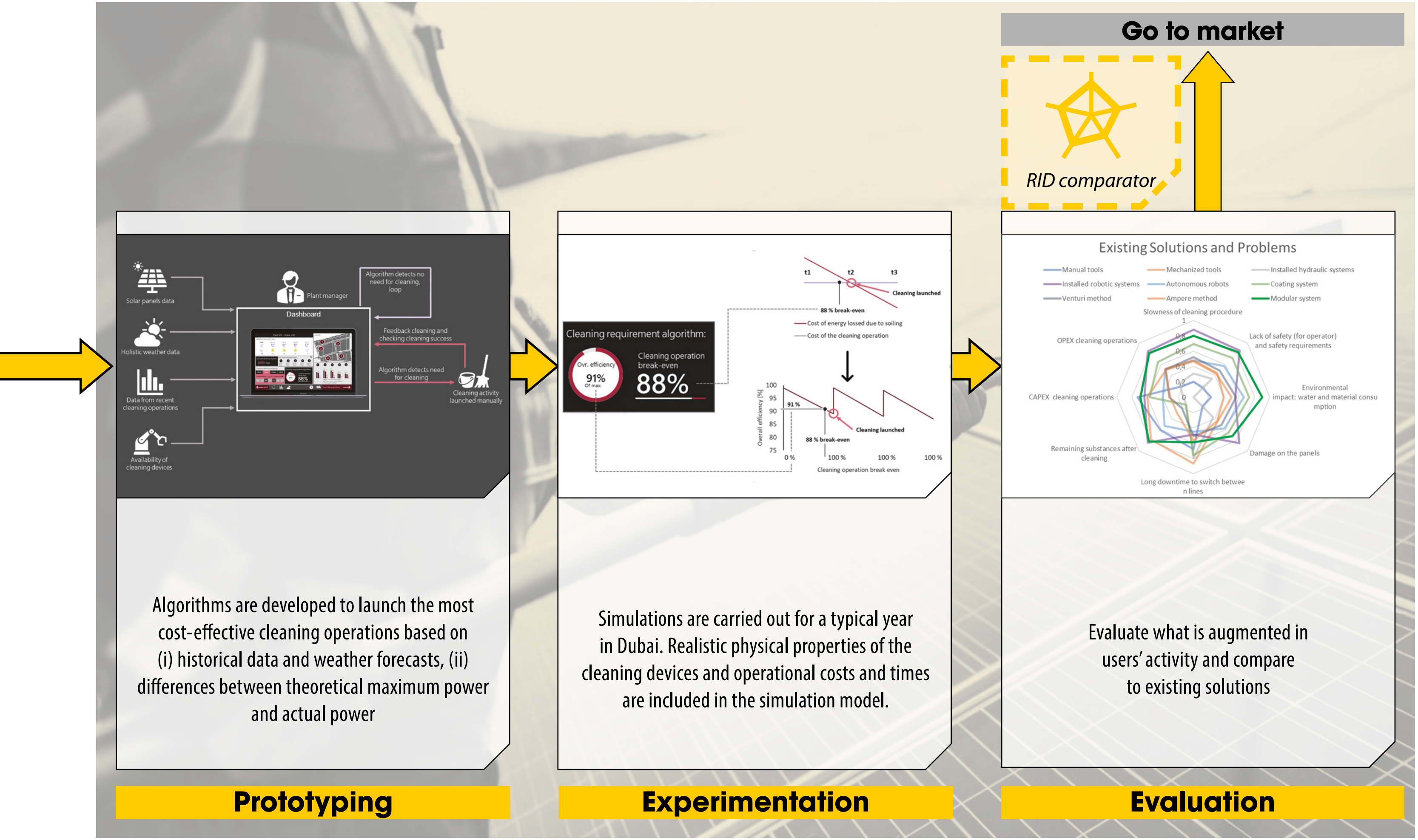
**Organization**
A global organization architecture is imagined





**Information system (IS) and regulation**
An IS and a dashboard for planning and real-time monitoring of the cleaning operations is imagined

**Detail design**



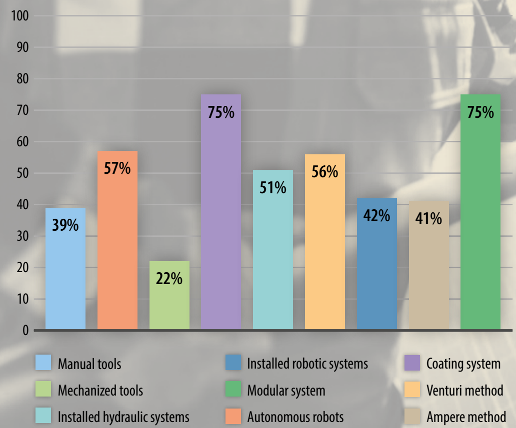
Go to market
RID comparator
Solar panels data
Holistic weather data
Data from recent cleaning operations
Availability of cleaning devices
Plant manager
Dashboard
Algorithm detects no need for cleaning, loop
Feedback cleaning and checking cleaning success
Algorithm detects need for cleaning
Cleaning activity launched manually
Algorithms are developed to launch the most cost-effective cleaning operations based on (i) historical data and weather forecasts, (ii) differences between theoretical maximum power and actual power
Prototyping
Cleaning requirement algorithm:
Ovr. efficiency
91%
Cleaning operation break-even
88%
t1
t2
t3
Cleaning launched
88 % break-even
Cost of energy lossed due to soiling
Cost of the cleaning operation
Overall efficiency [%]
91 %
Cleaning operation break even
Simulations are carried out for a typical year in Dubai. Realistic physical properties of the cleaning devices and operational costs and times are included in the simulation model.
Experimentation
Existing Solutions and Problems
Manual tools
Mechanized tools
Installed hydraulic systems
Installed robotic systems
Autonomous robots
Coating system
Venturi method
Ampere method
Modular system
Slowness of cleaning procedure
Lack of safety (for operator) and safety requirements
Environmental impact: water and material consumption
Damage on the panels
Long downtime to switch between lines
Remaining substances after cleaning
CAPEX cleaning operations
OPEX cleaning operations
Evaluate what is augmented in users' activity and compare to existing solutions
Evaluation

# Final evaluation of what is augmented in users' activity and comparison with existing solutions

*RID comparator*

## Cleaning solar panels RID study

**Global effectiveness**




## Analysis

The experimentation allows us to complete matrices *UpEs*, *UsEs*, *Esp* with rows and columns corresponding to our innovative modular system. Then, the RID comparator algorithm computes the effectiveness indicators for it.

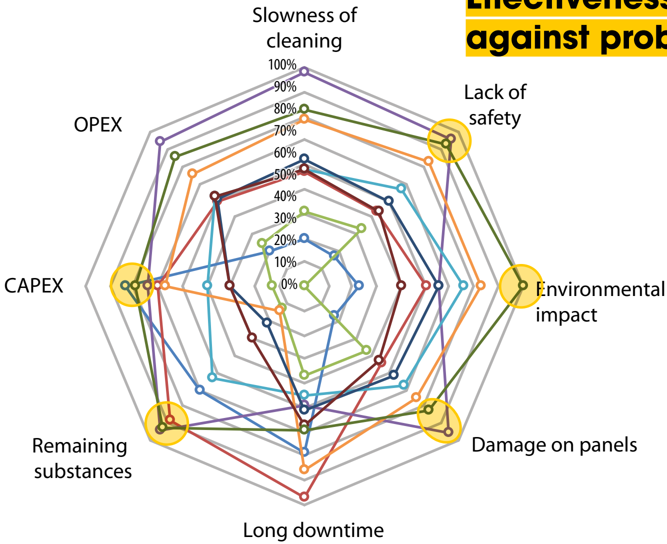
The global effectiveness of the new *modular system* (MS) is very high (75%) and comparable with that of *installed robotic systems* (IRS).

This is definitely the best solution for Dubai and the second best for Lagos. MS is also highly adapted to big plants at the same level than IRS and the best for float glass.

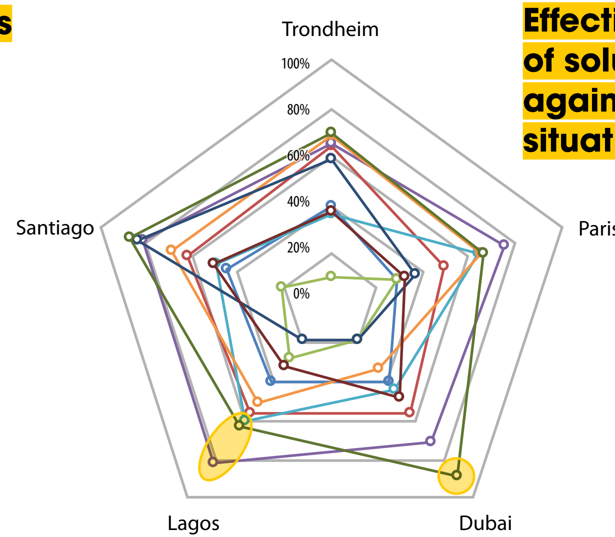
Last, this is by far the most environmentally friendly solution. MS is almost the best for coping with lack of safety, remaining substances and CAPEX, and is second below IRS for slowness of cleaning, OPEX, damage on panels. The only drawback is apparently its long downtime to switch between lines.

In conclusion, this final fine evaluation with the RID comparator fully validates the PSO solution part of the new *modular system*. Of course, a real size prototype of the product part and, further, of the whole PSO system, must be fabricated and ground-tested, and the business model refined and tested as well.

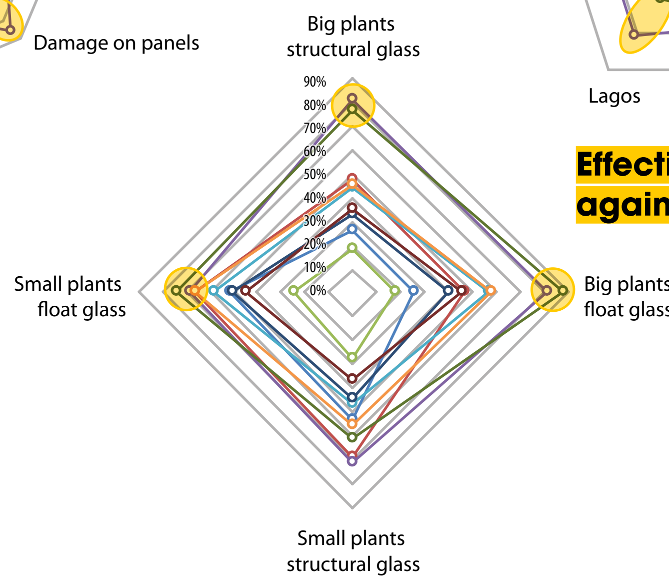
## Effectiveness of solutions against problems




## Effectiveness of solutions against usage situations




## Effectiveness of solutions against user profiles




- Manual tools
- Installed hydraulic systems
- Autonomous robots
- Venturi method
- Mechanized tools
- Installed robotic systems
- Coating system
- Ampere method

# Chapter 9

## Maturity and usefulness monitoring

Idea, scenario and concept maturation and selection

# 126 UNPC innovativeness indicators

**UNPC stands for Usefulness – Newness – Profitability – Concept**. The **UNPC innovativeness indicators** were created to assess, as early as possible, the **value** and the **maturity** of **ideas**, **scenarios** and **concepts** in a RID process, in order to make informed decisions about whether to continue with them and how to further develop them. **Usefulness** corresponds to the **expected gain of global effectiveness that** an innovative solution can provide compared to existing solutions. It is the most important indicator.

## When to use it?

**UNPC** is a smart model for shaping the **innovation funnel** (see **SAPIGE® method**). UNPC assessments can also be performed:

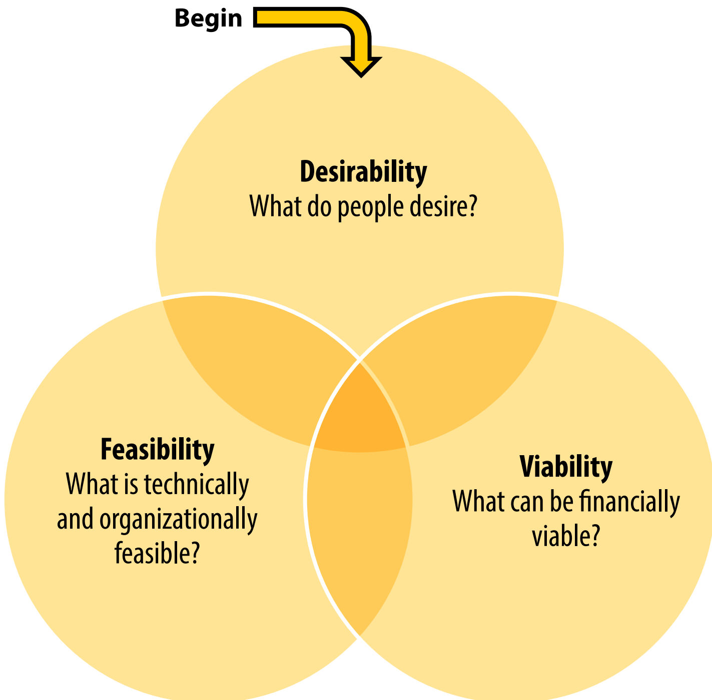
- to compare **ambition perimeters**,
- to operate the **BMC-RID** method,
- for **scenario creativity** and **concept creativity** stages to select and mature **ideas, dreamt usage scenarios** and **concepts** thanks to the **UNPC monitor tool**,
- to assess the chosen solution systematically in the **innovation dossier.**

## What is the difference with Design Thinking indicators?

Design Thinking (DT) indicators, which are **Desirability – Viability – Feasibility**, substantially differ from **UNPC** indicators. In DT, desirability corresponds to the achievement of the "wow effect" and is also close to our **Kano survey**. It reflects a consumerist **philosophy of innovation** while RID emphasizes **usefulness** in activity contexts, a usefulness that cannot necessarily be expressed by consumers alone.

## The Design Thinking innovativeness indicators

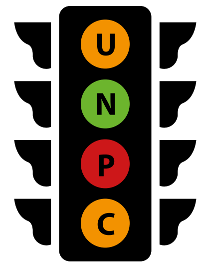
Adapted from IDEO Human Centered Design Toolkit




## The UNPC innovativeness indicators

Begin

| | |
|---|---|
| **Usefulness** | *That's useful!* (Important value buckets) |
| **Newness** | *It's new!* (patents, usage) |
| **Profitability** | *It's profitable for the user and the company!* |
| **Concept (proof of)** | *It works and it's achievable!* |




***SOURCE***

Yannou B., Farel R., Cluzel F., Bekhradi A., Zimmer B., 2016. The UNPC innovativeness set of indicators for idea or project selection and maturation in healthcare. *International Journal of Design Creativity and Innovation, 5 (3-4), 205-221.*

# 127 Usefulness indicator

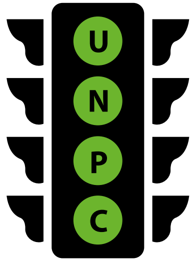
**Usefulness** is the most important indicator of the four **UNPC innovativeness indicators**, unique to RID. Proofs of usefulness exist when important needs in frequent usage situations are satisfied, people's suffering or pains (see **problems**) are alleviated, or malfunctions of existing solutions or systems are improved. In the case of high usefulness, the market size is likely to be large and, consequently, the demand for the product high.

**Usefulness** is at the heart of the **RID philosophy of innovation**; it reflects **humanist values** in a usage driven design. Usefulness can be measured in practice by the compliance of the innovative solution with the announced ambition perimeter, and the **increasing of global effectiveness** of the innovative solution compared to existing solutions.

In practice, RID practitioners are advised to assess proof of usefulness as early as the **problem setting** stage (see **SAPIGE® method**) as a new service may be assessed in terms of people's suffering or pains alleviated or malfunctions targeted, without precise descriptions of the solution details.

## UNPC proofs for the hairdressing chair and furniture for the elderly

UNPC indicators are used in a business innovation competition called "Bourse Silver Valley" (formerly "Bourse Charles Foix"). That's where this example comes from (see (Yannou et al. 2016)).





This example is an innovative hairdressing chair for the elderly proposed by an experienced engineer. During a period of unemployment, he overheard his wife complaining when she was styling the hair of elderly people in geriatric hospitals, retirement homes or at home. **For many elderly people, body motions, like neck movements, are limited, and they are often wheelchair-bound. Consequently, washing their hair can be quite painful, and hairdressing takes more time due to transfer and installation times. One direct result is that, on average, three fewer clients can be seen per day.** The engineer came to the innovation jury with videos taken by his wife, videos of the prototypes he built in his garage and testimonies of elderly clients in both conventional and new hairdressing chairs. As he convinced the jury (proofs of **usefulness** and proofs of **concept**), he patented his inventions (proof of **newness**) and the market was apparently huge (proof of **profitability**). He was not only awarded a prize in the innovation competition, but they also incubated his project for one year. He created a company that started industrial production with a full order book, because he was now able to ensure that hairdressers of the elderly have the same number of clients per day than any other hairdresser (proof of **profitability**).

***SOURCE***

Bekhradi A., Yannou B., Farel R., Zimmer B., Chandra J., 2015. Usefulness Simulation of Design Concepts. *Journal of Mechanical Design, 137 (7), 071414-071414-12.*

Wang J., Yannou B., Alizon F., Yvars P.-A., 2013. A Usage Coverage-Based Approach for Assessing Product Family Design. *Engineering With Computers, 29 (4), 449-465.*

Yannou B., Farel R., Cluzel F., Bekhradi A., Zimmer B., 2016. The UNPC innovativeness set of indicators for idea or project selection and maturation in healthcare. *International Journal of Design Creativity and Innovation, 5 (3-4), 205-221.*

# 128 Newness indicator

**Newness** is one of the four **UNPC innovativeness indicators**. It is composed of three aspects:

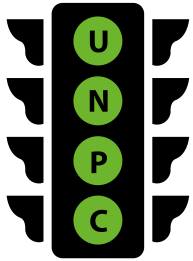
- Perceived newness by clients or end-users.
- Real technical newness, possibly patentable.
- Usage newness. Note that real usage newness may be poorly perceived, as the market may not be educated or sensitive to it.

As suggested by Talke, et al (2009) and Kazakci et al. (2014), **novelty** is crucial for innovation success.

In practice, RID practitioners are advised to assess proof of newness as soon as the **problem setting** stage (see **SAPIGE® method**) as a new service may be assessed in terms of novelty without precise descriptions of the solution details.

## UNPC proofs for the gardening table project

UNPC indicators are used in a business innovation competition called "Bourse Silver Valley" (formerly "Bourse Charles Foix"). That's where this example is taken from (see (Yannou et al. 2016)).





This innovative project was proposed by a young industrial designer. His observations in retirement homes showed that few activities were provided for the elderly and, consequently, the elderly in these homes were often bored. In addition, activities they used to practice when they were fully active - such as gardening - were now forbidden for reasons of physical disability and retirement home safety rules. He came up with an innovative gardening table project: a movable quadrant height-adjustable table with a set of ergonomic gardening tools. The tools and the table were designed and tested along with the help of elderly people and proved to be highly ergonomic (proof of **concept**), even for those who had hand disabilities or were wheelchair-bound. **The solutions were patented and the newness was clearly perceived by health professionals as well as gardening stores.** When the project was selected and incubated, there was a good likelihood that the **profitability** would be high; indeed, the elderly and professionals welcomed the product and the market appeared large. After four years, the startup company that was created produced and sold 200 table sets and sells even more gardening tools sets. Sixty retirement homes and geriatric services in hospitals have been equipped with these gardening solutions, freeing up time for health personnel (proof of **profitability**) and providing happiness and pride to the elderly (proof of **usefulness**).

***SOURCE***

Talke, K., Salomo, S., Wieringa, J. E., & Lutz, A. (2009). What About Design Newness? Investigating the Relevance of a Neglected Dimension of Product Innovativeness. Journal of Product Innovation Management, 26(6), 601-615.

Kazakci, A. O., Gillier, T., Piat, G., & Hatchuel, A. (2014, 23-25 June). *Brainstorming vs. Creative Design Reasoning: A Theory-Driven Experimental Investigation Of Novelty, Feasibility And Value Of Ideas.* DCC'14: International Conference on Design Computing and Cognition, London, UK.

Yannou B., Farel R., Cluzel F., Bekhradi A., Zimmer B., 2016. The UNPC innovativeness set of indicators for idea or project selection and maturation in healthcare. *International Journal of Design Creativity and Innovation.*

# 129 Profitability indicator

**Profitability** is one of the four **UNPC innovativeness indicators**. It concerns expected profits for the company, as well as for customers. Profitability is related to costs:

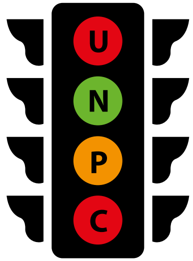
- From the viewpoint of producers, this is the elementary margin on a product unit.
- From the viewpoint of users, this is the total cost of ownership.

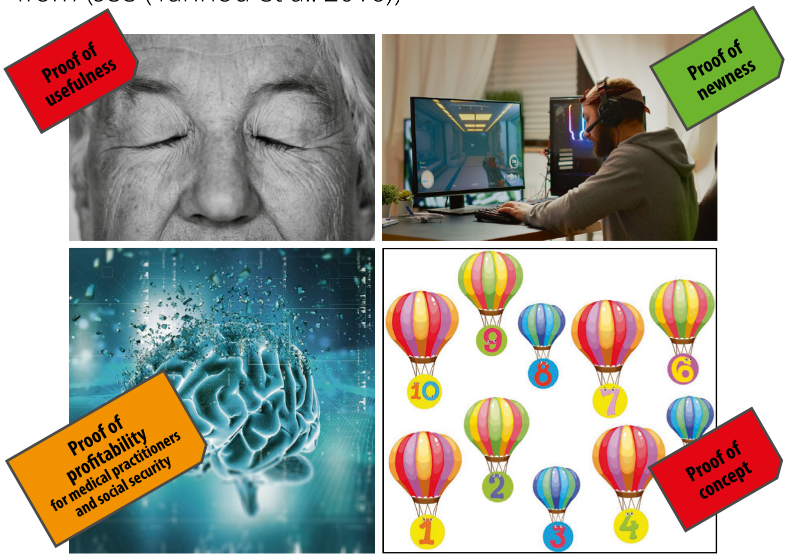
Proofs of profitability may also characterize the ability to improve brand image, increase the average revenue per user, conquer new markets or make clients more loyal (higher re-purchasing rate).

In practice, RID practitioners are advised to assess **profitability** only in the **problem solving** stage (see **SAPIGE® method**) as one must not presume of costs and profits (depending from the desirability on the market and of the designed business model) before the solution is detailed enough.

## UNPC proofs for the Alzheimer's-First-Person-Shooting project

UNPC indicators are used in a business innovation competition called "Bourse Silver Valley" (formerly "Bourse Charles Foix"). That's where this example comes from (see (Yannou et al. 2016))




**SOURCE**

Kornish, L. J., & Ulrich, K. T. (2014). The Importance of the Raw Idea in Innovation: Testing the Sow's Ear Hypothesis. *Journal of Marketing Research, 51*(1), 14-26.

Yannou B., Farel R., Cluzel F., Bekhradi A., Zimmer B., 2016. The UNPC innovativeness set of indicators for idea or project selection and maturation in healthcare. *International Journal of Design Creativity and Innovation, 5 (3-4), 205-221.*

A group of six highly-educated engineers and business managers from prestigious universities proposed a concept of developing First-Person-Shooting (FPS) applications to (a) detect (b) prevent by training (c) reeducate once started, people suffering from Alzheimer's disease. In FPS games, the gamers must, within a limited time, target some graphical objective and press the button – for example, shoot or pop a balloon. They based their proposal on a unique and dated scientific publication – not provided to jury members – that a correlation (no figures provided) – had been established between Alzheimer's disease and the ability to get a high score at FPS contests. This group of six was well respected, since they had founded a start-up company two years before and launched two e-healthcare apps. But there was not enough evidence that useful information could be derived from personal prowess in this type of game, particularly for people not familiar with gaming (lack of proof of **concept**). In addition, they wanted to develop a pre-diagnosis platform for automatically making appointments with neurologists, as soon as the first signs of Alzheimer's disease were detected: patients' states deteriorate during the long wait for appointments with neurologists, who are overbooked. The innovation jury considered such assertions to be based on false explanatory principles and misguided interpretation, and more research would have been necessary before starting product-service development. The service's effectiveness was far from being proven (lack of proof of **usefulness**). In addition, the benefits for both patients and healthcare professionals were probably non-existent (lack of proof of **profitability**). Finally, this project was not selected, and the start-up later gave up the project.

# 130 Concept (Proof of) indicator

**Concept** (proof of) is one of the four **UNPC innovativeness indicators**.

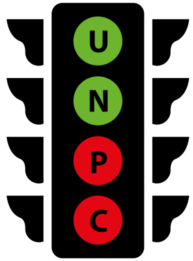
Proof of Concept is twofold:

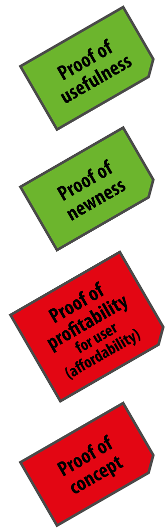
- For the users, it is proof that the conceptual solution or prototype functions effectively and efficiently in expected usage situations.
- For the manufacturer, it is proof of technological and industrial feasibility.

As suggested by Kazakci et al. (2014), **feasibility** is crucial for innovation success in practice.
In practice, RID practitioners are only advised to assess **proof of concept** in the **problem solving** stage (see **SAPIGE® method**) as one must not assume low industrial feasibility or low service delivery **effectiveness** before the solution is detailed enough.

## UNPC proofs for the walking frame project

UNPC indicators are used in a business innovation competition called "Bourse Silver Valley" (formerly "Bourse Charles Foix"). That's where this example comes from (see (Yannou et al. 2016))




This project presented impressive images of an innovative, mechanized and apparently flexible walking frame in curb-crossing configurations. This walking frame is made of two engine-assisted triangular caterpillars designed to supposedly climb sidewalks and obstacles while maintaining stability and verticality. This was apparently a first-rate idea, since the young industrial designer, the author of this proposal, had just received the first substantial prize of a famous innovation competition. Here, **usefulness** is unquestionable, but the attention of some jury members focused on the **effectiveness** of the system in a typical **usage situation**. One question posed to the industrial designer was: "What happens if the aided person grasping the two handles suddenly stumbles?". The designer was unable to answer. According to her explanations, the walking frame would have sped up as the user pushed the handles forward upon stumbling, resulting in a dangerous fall. This is a typical example of a positive amplification open loop in control theory, a discipline which was unfamiliar to the industrial designer. In addition, the vertical stabilization and stiffness of the walking frame should enable a sophisticated level of control, and this element was ignored by the innovator. In conclusion, there was evidence of a lack of **proof of concept**. The project was not selected by the jury members and the entrepreneur abandoned the project two years later.

***SOURCE***

Kazakci, A. O., Gillier, T., Piat, G., & Hatchuel, A. (2014, 23-25 June). *Brainstorming vs. Creative Design Reasoning: A Theory-Driven Experimental Investigation Of Novelty, Feasibility And Value Of Ideas*. DCC'14: International Conference on Design Computing and Cognition, London, UK.

Yannou B., Farel R., Cluzel F., Bekhradi A., Zimmer B., 2016. The UNPC innovativeness set of indicators for idea or project selection and maturation in healthcare. *International Journal of Design Creativity and Innovation, 5 (3-4), 205-221.*

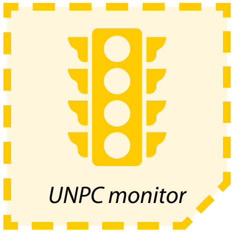
# 131 UNPC monitor tool

**UNPC monitor** is a tool for concurrently increasing the maturity of a subset of innovative **ideas, scenarios** or **concepts**, and for finally selecting one of them. It is used in the **scenario creativity** and **concept creativity** stages in the convergent parts of the creativity sessions (see **solution design**).

The **UNPC monitoring** process starts with the **SWOT analysis** of competing ideas. It then becomes dynamic, looking for new evidence for increasing the **certainty** and **impact** of the UNPC indicators for competing ideas.

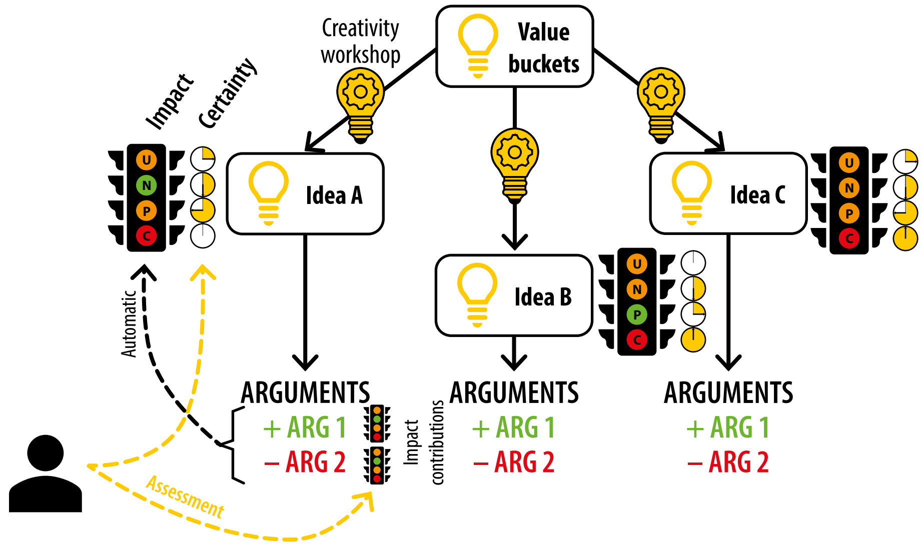
**Evidence arguments** are then collected under each of the U|N|P|C indicators. Each argument may be a pro or a con for modifying the **impact** (on a scale from -3 to +3) of one of the U|N|P|C indicators, the **impact** scores being automatically averaged for any of the U|N|P|C indicators of the idea. For every new argument, the **certainty** of the corresponding U|N|P|C indicator is manually updated on a scale between 0% to 100%.

The process ends when sufficient **certainty** is reached, and the best idea with the best UNPC **impact vector** is then chosen. Of course, trade-offs must often be made between **usefulness**, **newness**, **profitability** and **concept** advantages. These trade-offs depend on the project, the product line and the company strategy.

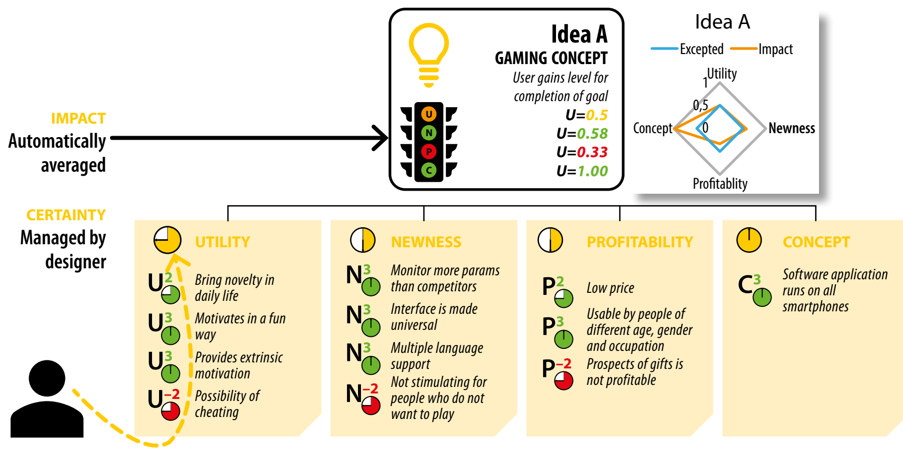



## The UNPC monitoring process

1. Gathering UNPC evidence/ARGuments,
2. Automatic calculation of idea impact,
3. Manual updating of idea certainty.




UNPC arguments, impact and certainty vectors for idea A, represented in UNPC-monitor tool




### *SOURCE*

Yannou B., Farel R., Cluzel F., 2015. The UIPC monitor tool for augmenting idea maturity with proofs of utility innovation profitability and concept, *In ICDC: The Third International Conference on Design Creativity, Jan 12-14, Bangalore, India.*

# SAPIGE® method

## SAPIGE® method: the two-stage idea selection process

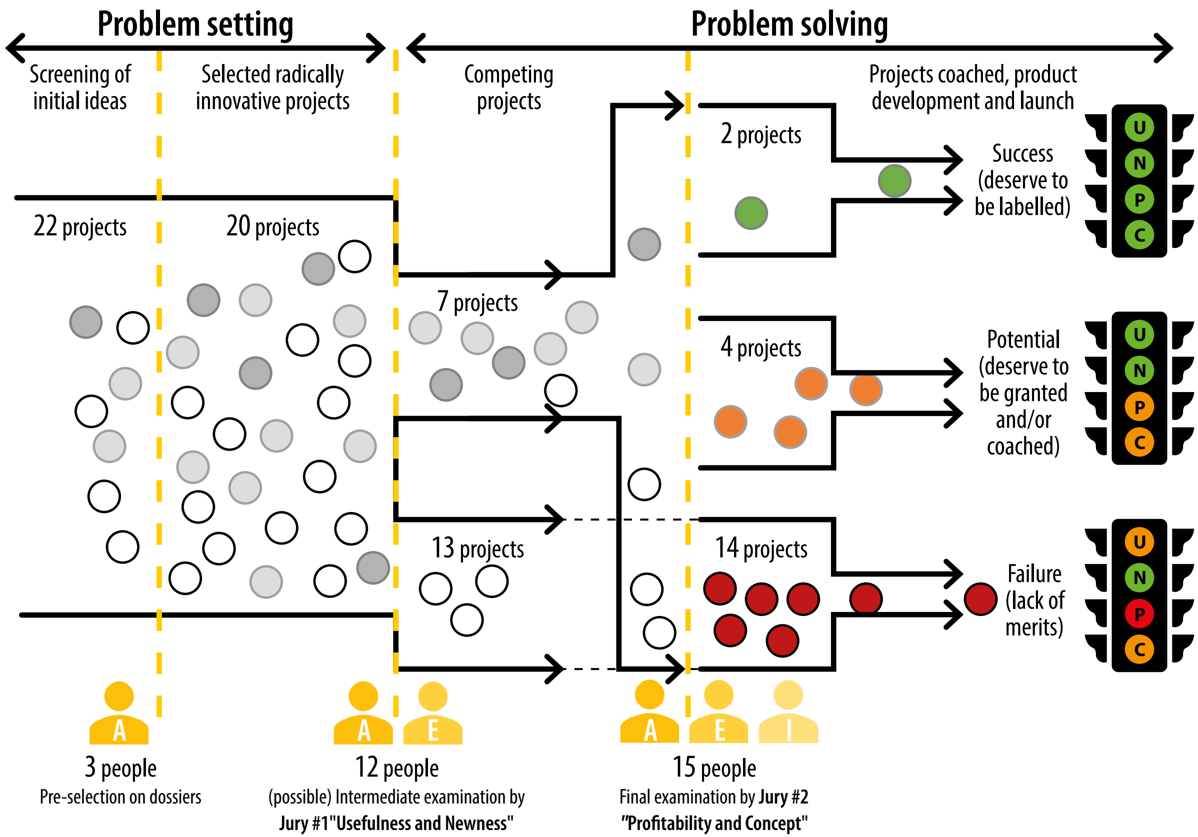
**SAPIGE®** is a RID method based upon **UNPC innovativeness indicators**. It is used by selection juries, both in companies and during open-innovation competitions, to monitor the innovation funnel in selecting and ranking innovative ideas and projects in a two-stage selection process. It is also used to perform **360° innovation diagnostics**, leading to appropriate SAPIGE® incubated coaching.

The **SAPIGE®** two-stage idea selection process aims first to eliminate the low **usefulness** and low **newness** ideas, scenarios or concepts, and then, for the remaining candidates, to eliminate those with low **profitability** and low (proof of) **concept** in a second round. The perfect (UNPC) projects can only be awarded prizes, whereas the good (UN) but questionable (PC) projects must not only be awarded prizes, but also granted money and incubated, as they reveal high potential for success and need help to gain in **maturity**.

**SAPIGE®**, standing for *Système de sélection et d'Accompagnement de Projets d'Innovation en Gerontechnologie* (selection and coaching system for innovative projects in gerontechnology), was coined by (Zimmer, 2012).

## How to organize a selection jury of an innovation competition?

The **selection juries** are composed of three bodies of members:
A for Academics, E for innovation Experts and I for Industry executives.
The first problem setting jury is composed of members of the A and E bodies, and the second problem solving jury is composed of members of the A, E and I bodies.




***SOURCE***

Zimmer B., 2012. *Structuration d'un cluster d'innovation: Application aux projets d'innovation dans une grappe d'entreprises en gérontechnologie. Thèse de Doctorat. Ecole Centrale Paris, Laboratoire Génie Industriel.*
Bernard Yannou, Romain Farel, François Cluzel, Alexandre Bekhradi, Benjamin Zimmer. User-centered selection of innovative ideas and projects for incubation. [Research Report] CentraleSupélec.2017.

# 132 SAPIGE® method

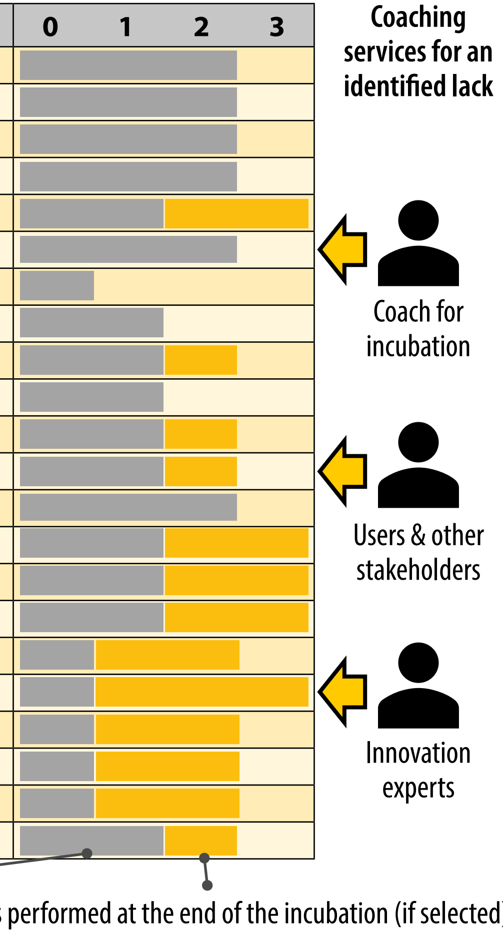
## SAPIGE® method: The 360° innovation diagnosis and incubated coaching

360° innovation diagnosis can be performed during the **SAPIGE®** selection process in an innovation competition, or just afterwards in the case of selected projects. A chart of 22 pieces of evidence illustrates UNPC proofs and serves for a precise rating system as well as for a preliminary 360° innovation diagnosis system. For any identified shortfalls in a selected project, an appropriate plan of coaching services is designed and applied. Once the incubation period is complete, the final 360° innovation diagnosis is launched to mark progress and identify the remaining areas for improvements.

### SAPIGE® 360° innovation diagnosis template

This chart of 22 pieces of evidence is the template for both the primary and the final 360° innovation diagnosis, when a promising innovative project is selected and incubated for improvement.

| Stage | Proof type | Evidence |
|---|---|---|
| **Problem design or "Usefulness & Newness"** **Jury #1** | Proofs of **Usefulness (U)** | Definition of the general problem |
| | | Identification of the target |
| | | Relevance of the usage |
| | | Ideal need expression |
| | | Integration of the constraints (legislative, legal ethical, economic) |
| | Proofs of **Newness (N)** | Knowledge of the value chain |
| | | Legal watch |
| | | Technical and economic watch |
| | | Exploitation of the value buckets |
| **Solution design or "Profitability & Concept"** **Jury #2** | Proofs of **Concept (C)** | Planning of the project's actions |
| | | Description of the concept |
| | | Financial management of the project |
| | | Degrees of skill and knowledge of the project initiator |
| | | Existence of project partners |
| | | Risk analysis of the project |
| | | Validation process of the developmental milestones of the project |
| | Proofs of **Profitability (P)** | Development of the distribution chain of future product/service |
| | | Development of the value creation strategy |
| | | Development of the business strategy |
| | | ROI for the project initiator |
| | | Quantification of the service provided for the usage |
| | | Quantification of the service provided for the user |




*SOURCE*

Yannou B., Zimmer B., Farel R., Jankovic M., Stal Le Cardinal J., 2013. Proofs of Utility, Innovation, Profitability and Concept for innovation selection, *In ICED: 19th International Conference on Engineering Design, 19-22 August, Seoul, Korea.*

# Chapter 10

## Business design

# 133 Why do innovations fail?

Many studies agree that the main reason for the **failure of an innovation** on the market is the mismatch between the proposed offering and the real needs of the market, in short: a **poor product-market fit**.

For instance, *CB-Insights* study analyses the top 12 reasons of start-up failures - by analyzing 110+ start-up failure post-mortems. Just after the failure to raise new capital (which is common for a start-up), comes the **non-existence of market need** in 35% of cases. It is the same for well-funded and initially successful companies which can fail if they do not continuously align their products with market needs and preferences.

This underlines the **importance of adopting user-centred design and market analysis approaches, and mechanisms that link the two** such as Radical Innovation Design.

## Top reasons startups fail

| Reason of failure | Frequence |
|---|---|
| Ran out of cash/failed to raise new capital | 38% |
| No market need | 35% |
| Got outcompeted | 20% |
| Flawed business model | 19% |
| Regulatory/legal challenges | 18% |
| Pricing/cost issues | 15% |
| Not the right team | 14% |
| Product mistimed | 10% |
| Poor product | 8% |
| Disharmony among team/investors | 7% |
| Pivot gone bad | 6% |
| Burned out/lacked passion | 5% |

*SOURCE*
CB Insights, 2021, The Top 12 Reasons Startups Fail.

# 134 5 reasons for a bad product-market fit

**1. False need** or the solution is unnecessarily complicated and technologically sophisticated

- **Juicero:** Juicero was an American company that designed, manufactured and sold the Juicero Press, a fruit and vegetable juice extractor. The Juicero Press was Wi-Fi enabled and used exclusive single-serve packs of pre-chopped fruit and vegetables, delivered to the customer exclusively by the company on a subscription basis. The company attracted negative media attention when consumers and journalists discovered that its juice pouches could be squeezed just as easily by hand as with the company's expensive machine.
- **SFR Box 8:** At the time of its launch, SFR's Box 8 was criticized for its superfluous functions and high price, failing to meet French consumers' expectations of simplicity and efficiency when it came to Internet boxes.

**2.** Innovation is useful and performative, but **not mature enough**

- **Apple Newton:** One of the first personal digital assistants (PDAs), launched by Apple in 1993. Although a notable innovation for its time, the Newton suffered from a number of problems, including high price, imposing size, and problems with handwriting recognition. These limitations made the product less attractive to the consumer market, and it was eventually replaced by more powerful and user-friendly devices.

**3.** The **product-market fit is not right**, or innovation has broken down

- **Segway:** Despite initial media hype, this personal electric vehicle, billed as revolutionary, has failed to establish itself in a clear market segment, struggling to find a broad consumer base due to its high price and regulatory restrictions in many places.

- **Google Glass:** While technologically advanced, it did not align with consumer expectations for wearables regarding privacy and everyday utility.
- **Moulinex:** A French company known for its small household appliances which went bankrupt in 2001. This was attributed to a combination of problematic internal management, increased competition, and perhaps a lack of innovation adapted to market developments and consumer needs.

4. Needs are changing, and **some technologies are no longer adapted** to these new needs
    - **Nokia:** Once the world's leading mobile phone manufacturers, Nokia did not adopt the Android operating system and was quickly overtaken by competitors who did.
    - **BlackBerry:** Once a leader in the smartphone market, BlackBerry failed to adapt to the touch-screen trend and competition from Apple and Android.
    - **Kodak:** Despite its pioneering role in photography, Kodak was unable to make the transition to digital quickly enough to maintain its leading position.
    - **Minitel:** Although Minitel enjoyed some success in France, its international expansion failed, mainly because of the growing popularity of the more open and versatile Internet.

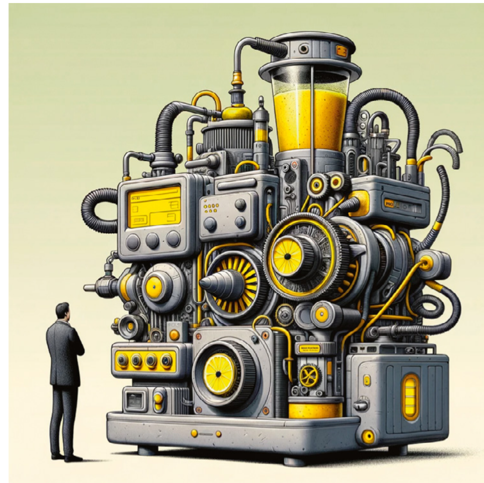
5. Needs are changing, and **some business models are no longer adapted** to these new needs
    - **Copains d'Avant:** A popular French social network in the 2000s, enabling users to find old school friends, Copains d'Avant has struggled to adapt to the rapidly changing social networking market, particularly in the face of international competitors such as Facebook.
    - **La Camif:** This French mail-order cooperative for teachers went into receivership in 2008, unable to compete with new online consumer habits.

# 135 Where is the right balance between value proposition and market need?

One of the reasons for **poor product-market fit** is the proposal of unnecessarily complicated and technologically sophisticated innovations that ultimately do not meet fundamental or widespread needs. The technological resources invested and the resulting costs are not worth the additional or specific service provided by the solution. Radical Innovation Design's concept of **value bucket** enables us to measure the additional service provided by the innovative solution in relation to other solutions on the market.

### How far can technological sophistication go?

Many people will be happy with a manual citrus press, which can do without electricity, especially as lifestyles need to become more frugal. Some people who love the vitamin-rich properties of fruit will want to buy a juice extractor. The Juicero Press is not only incompatible with respect for the environment, it is also emblematic of a gadget machine.



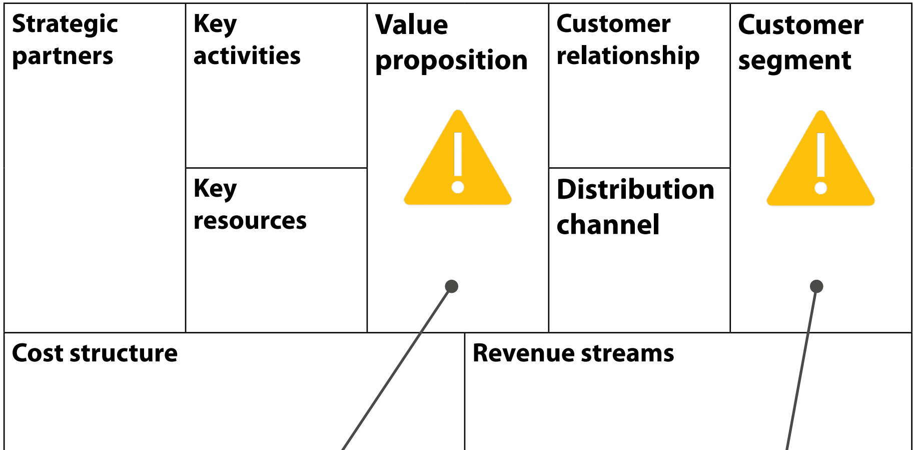
# 136 The inherent limits of the Business Model Canvas

A **Business Model Canvas** **(BMC)** is, according to its creators Osterwalder and Pigneur in 2010 [1], a "**tool for describing how an organization creates, delivers and captures value**".

The BMC is undoubtedly a good tool for innovating a business model. But many failures have been seen when value propositions (the central and primary block of the BMC) were insufficiently substantiated, and also insufficiently linked to customer segments, often causing startups to pivot after years of stagnation.

Aware of these weaknesses, Osterwalder and Pigneur proposed a complementary Value Proposition Canvas in 2014 [2]. But despite some improvements in linking customer segments to Value Proposition elements, the problem persists because the Value Proposition itself is often weak, arbitrary, unfounded, unjustified.

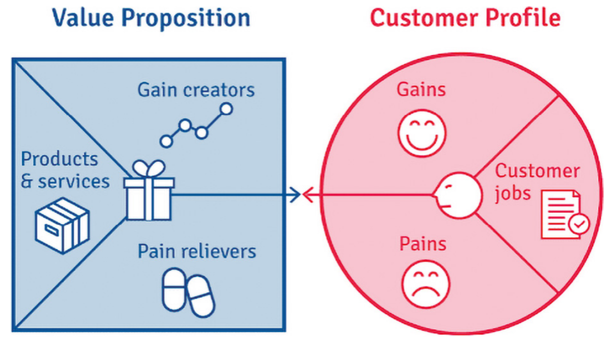
## The Business Model Canvas [1]




Often weak, arbitrary, unfounded, unjustified

Often not linked enough to value proposition items

## The Value Proposition Canvas [2]




***SOURCE***
[1] Osterwalder A., Pigneur Y., 2010. *Business Model Generation, Hoboken, New Jersey: John Wiley & Sons, Inc*, ISBN: 978-0-4708-7641-1.
[2] Osterwalder A., Pigneur Y., Bernarda G., Smith A., Papadakos P., 2014. *Value Proposition Design, Hoboken, New Jersey: John Wiley & Sons, Inc*, ISBN: 978-1-1189-6805-5.

# 137 BMC-RID, an adapted BMC to RID methodology

**BMC-RID** [1, 2] is the name of the method used in the **business design** sub-process. The **Business Model Canvas**, by Osterwalder and Pigneur, is made more robust thanks to two RID advantages:

1. **The canvas is initiated with the ambition perimeter** as early as the ambition perimeter is decided. The (usage situations, problems) pairs of the selected macro value buckets are injected into the value proposition block. The user profiles part of the macro value buckets are injected into the customer segment block, and the links with the value proposition elements kept. In doing so, BMC-RID naturally guarantees that the value proposition is well-founded and that the product-market fit is not arbitrary as well.

2. **A set of UNPC innovation indicators is assigned to each of the nine BMC-RID blocks**. In this way, each block can be seen as an ideation space, with numerous competing ideas under instruction, for which the impact and certainty of innovation is monitored, before leading to the choice of a mature and optimal solution for each block. In this way, the business model innovation process is fragmented, parallelized as far as possible, and secured.

BMC-RID

# BMC-RID example of the Accesseat RID study

The numbering of blocks indicates the order of block filling in general.

**We believe that with BMC-RID, the weakest points of the traditional BMC have been addressed.**

Ambition perimeter

Usage Situations × Problems × User Profiles

### Strategic partners
- RIDers
- Silver Valley
- Insurance company
- Health organizations

8

### Key activities
- Conceiving an efficient solution responding to the elderly's "pain" point

6

### Key resources
- RIDers
- Faurecia
- Seating division
- Patterns of the Accesseat concept

7

### Value proposition
- Facilitating movements without disturbing habits and without being intrusive
- Helping the elderly to enter and leave a vehicle
- Discrete/invisible product
- Not stigmatizing

1

### Customer relationship
4
- Personal assistance in showrooms that allow people to test the product
- Create a community with SilverValley in order to create a word-of-mouth effect
- Suggestions from peers (family or other elderly people)

### Distribution channel
- Retailer
- Special showrooms
- OEM

3

### Customer segment
- Elderly person (62+) on the car as driver or passenger
- Relatives of elderly people
- Possible segment:
- People with movement restrictions
- Pregnant women

2

### Cost structure
- Cost of development
- Economy of scale due to the growing size of the aging population

9

### Revenue streams
- Asset sale
- Brand loyalty by elderly people who feel understood

5


*SOURCE*

[1] Bekhradi A., Yannou B., Cluzel F., Chabbert F., 2016. Importance of problem-setting before developing a business model canvas, In Int. Design Conf., May 16-19, Dubrovnik, Croatia.

[2] Bekhradi A., 2018. Planning technology maturation by exploration of useful problems in markets: The case of innovative startups. PhD thesis. Université Paris-Saclay.

# 138 Dynamic management of the BMC-RID

The **BMC-RID canvas must be managed dynamically** through these 5 steps:

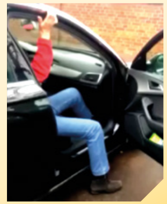
1. **Initiate BMC**: Start feeding the two main canvas blocks: value proposition and customer segment, with macro value buckets originated from the ambition perimeter
2. **Maturate VP and CS blocks:** Make sure that Usefulness/Newness indicators (UN out of UNPC) have been made green for these 2 blocks by sufficient concept maturation (using UNPC monitor tool)
3. **Ideate other blocks:** Complete the 7 remaining BMC blocks (possibly innovative)
4. **Maturate blocks:** Get as many green UNPC indicators as possible for the 9 BMC blocks
5. **Recommend:** Summarize the final state of the canvas and make recommendations for the innovation dossier

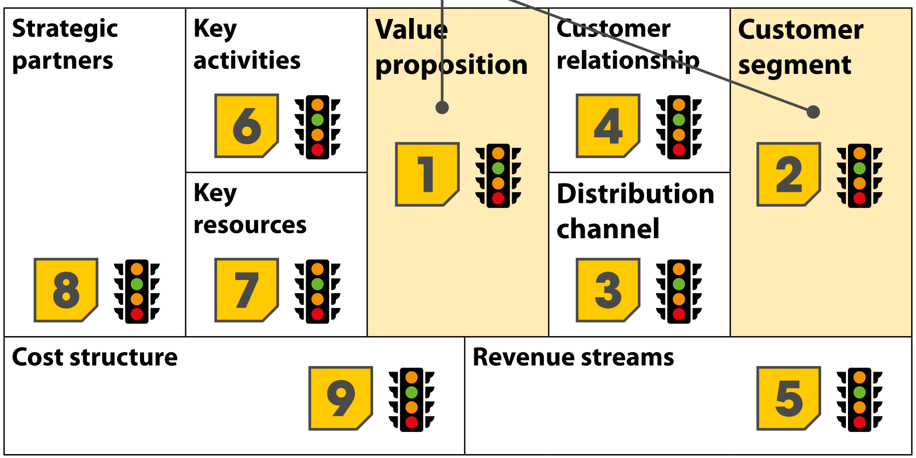
It should be noted that the **business design** sub-process can run concurrently with the **solution design** sub-process. Constant to-ing and fro-ing can take place between the two sub-processes, with no pre-eminence of one over the other. This, too, is a specific feature of RID methodology.

## The dynamic management of BMC-RID – Accesseat RID study

### Ambition perimeter (here made of VB1)

| | Physical pain | Movement restrictions | Discomfort |
|---|---|---|---|
| Sitting down | 15 | 20 | 9 |
| Putting and removing seat belt | 15 | 16 | 9 |
| Getting out of the vehicle | 20 | 20 | 12 |






### Dreamt usage scenario

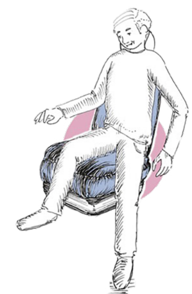
### The Valet

To create a comfortable and safe user experience from installation to uninstallation with the aid of inflatable cushions.

A valet opens the door for you as you approach. She/he is considerate: by guessing your intention to sit down she/he will move the seat forward for you, and you will be able to sit down without worrying and without significant effort.

### Conceptual solution

(the inflatable cushion seat)



*SOURCE*

Bekhradi A., Yannou B., Cluzel F., Chabbert F., 2016. Importance of problem-setting before developing a business model canvas, *In International Design Conference, May 16-19, Dubrovnik, Croatia.*

# Conclusion

## Summary of RID advantages

# 139 RID in brief

## In brief, how to define Radical Innovation Design?

**Radical Innovation Design** is a novel, complete and well-structured innovative design methodology that prioritizes the improvement of the **user experience** within a **context of activity**. RID considers innovative design as the improvement of the activity-support-system to augment the performances of a future activity. Indeed, in Engeström's Activity System Diagram theory, the designed solution that serves for supporting an activity is called a mediating artefact which corresponds to a **Product-Service-Organisation** in RID.

RID guides innovators who want to systematically explore users' problems and unstated needs, and evaluating which ones are most pressing in terms of innovation, taking into account the **effectiveness of existing solutions** in contributing to a satisfactory practice of activity. RID renews the way to define innovation targets along with a prioritized set of **value buckets** in adequacy with company strategy. Value buckets, which are frequent **usage situations** where major problems are experienced and for which the **existing solutions** provide little or no relief, are **qualified questions** for usefully start ideation sessions with the guarantee that, if value buckets are cracked, then unaddressed usefulness value is created for users. With its emphasis on **problem exploration**, RID differs from methods based on early prototyping. The RID methodology has been validated in various industrial and business sectors.

**Radical Innovation Design® is a trademark.**

**This trademark and RID Intellectual Property belong to CentraleSupélec.**

**RID has been invented by Professor Bernard Yannou.**

**CentraleSupélec lets commercial exploitation rights to HyB'RID startup company.**

**HyB'RID has been co-founded by Bernard Yannou and François Cluzel.**

Radical Innovation Design

CentraleSupélec

HyB'RID

# 140 What makes RID unique?

Our method leaves no room for suggestiveness, and our original metrics of "**quantity of pains**" and "**effectiveness indicators**" are calculated from data derived from the construction of a cognitive model of activity based on 7 factual questions about activity practice. These 7 questions are meticulously answered by data coming from scientific studies and statistics on frequency of problems in usage situations, severity of problems by user profiles, effectiveness of access to solutions by user profiles, etc. (see the process of feeding and exploring the cognitive model).

Our metrics are objective functions that objectively measure **how to satisfactorily cover usage situations**. The RID inventors have already published several journal articles on this subject [1-4]. To our knowledge, they are the only ones to have proposed these **metrics of usage coverage**, which appear to us as the best quantitative **measurement that should drive the willingness to further explore innovation leads** (what we call **value buckets**). The Radical Innovation Design approach uses the **same usage coverage principle but in a simpler, more qualitative way** and in a "**design thinking**" **type process**.

1. Bekhradi A, Yannou B, Farel R, Zimmer B, Chandra J (2015) Usefulness simulation of design concepts. Journal of Mechanical Design, 137(7): 071414.

2. He L, Chen W, Hoyle C, Yannou B (2012) Choice modeling for usage context-based design. Journal of Mechanical Design 134(3):031007.

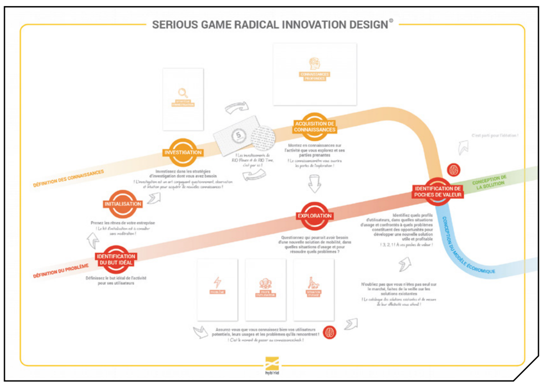
3. Wang J, Yannou B, Alizon F, Yvars P-A (2013) A usage coverage-based approach for assessing product family design. Engineering with Computers 29(4):449–465.

4. Yannou B, Yvars P-A, Hoyle C, Chen W (2013) Set-based design by simulation of usage scenario coverage. Journal of Engineering Design 24(8):575–603.

# 141 RID at a glance

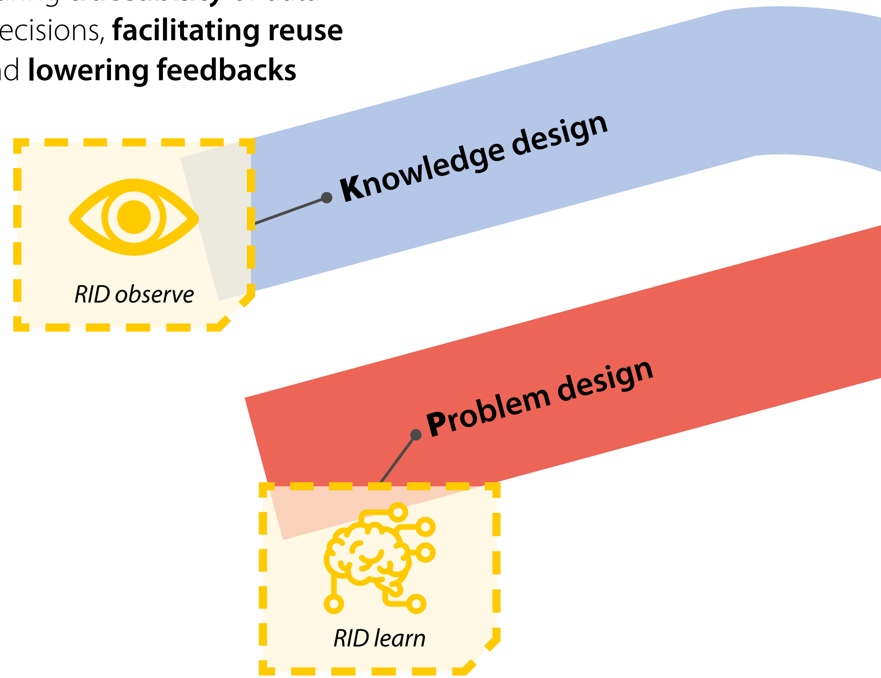
## Own concepts and terminology

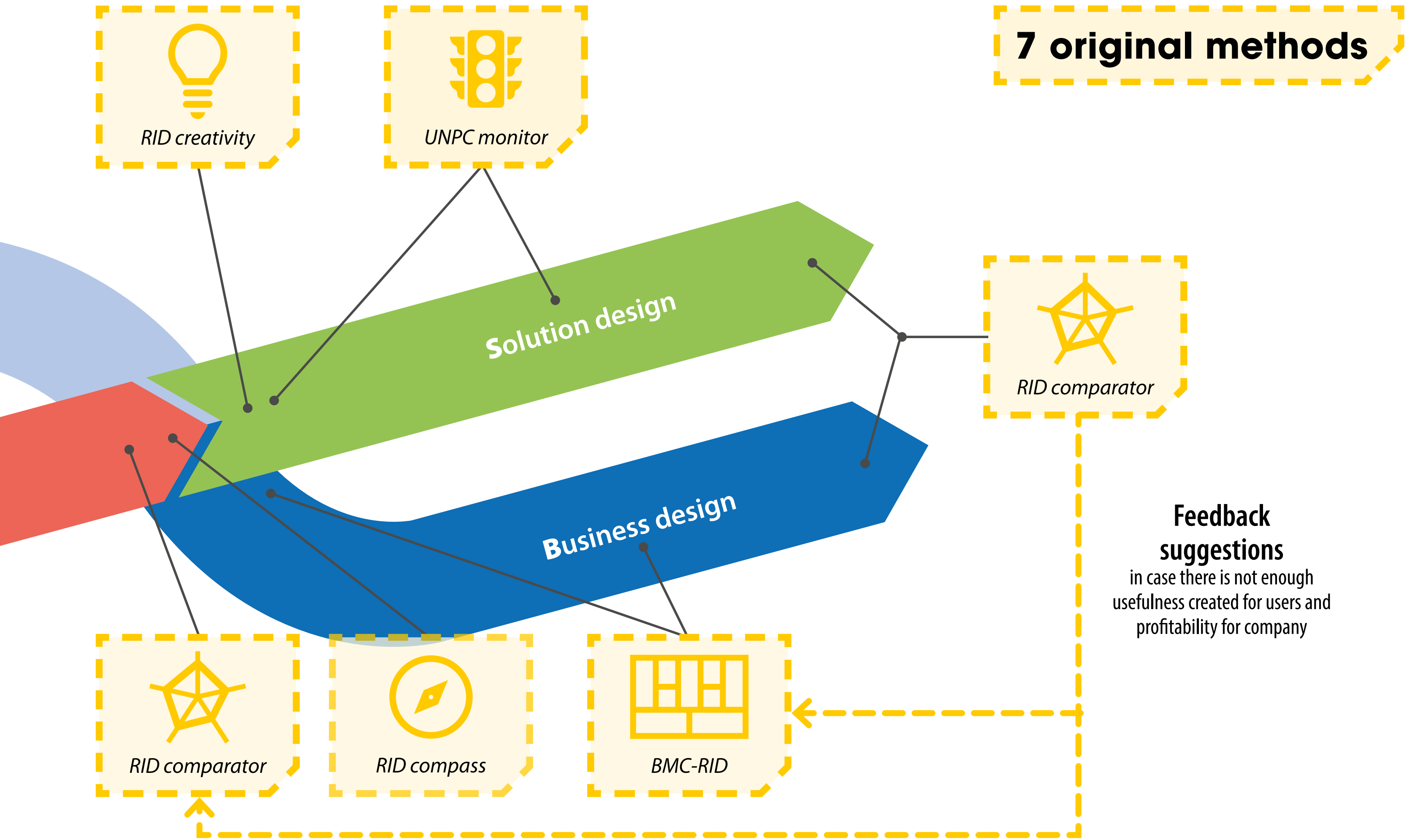

## A serious game




## An organized process

ensuring **traceability** of data and decisions, **facilitating reuse** and **lowering feedbacks**




RID creativity
UNPC monitor
7 original methods
Solution design
Business design
RID comparator
Feedback suggestions
in case there is not enough usefulness created for users and profitability for company
RID comparator
RID compass
BMC-RID

# 142 Links with other approaches

## Engineering Design

### Design Thinking

Despite common **user-centered** and **ethnographic** approaches, RID prefers (i) a systematic exploration of **value buckets** after carefully building a **cognitive model** of the activity instead of applying the *fail fast* principle, and (ii) RID innovation is governed by **usefulness** instead of *desirability*.

### Double Diamond design process

RID has extended the **Double Diamond design process** into a **Quadruple Diamond process** made of two first parallel **exploration-exploitation** of the **knowledge** and **problem**, followed by two parallel exploration-exploitation of the (PSO) **solution** and **business** (model).

Radical Innovation Design

## Innovation Management

### Blue Ocean Strategy (BOS)

The *Strategy Canvas* of BOS is considered as a central diagnostic tool and an action framework for building a compelling blue ocean strategy. In RID, comparable ***effectiveness graphs*** are automatically obtained from the built cognitive model with less subjectivity. **RID Comparator** and **RID compass** are methods and tools for exploring how people truly experience the activity, and decide how to shrink the market space to concentrate on, and which innovation leads (**value buckets**) can make the difference in terms of usefulness for users and profitability for company. In fact, RID provides tools that allow BOS to be implemented.

### Business Model Canvas (BMC)

BMC is a good tool for innovating a business model. But many failures have been seen when value propositions were insufficiently substantiated and linked to customer segments, often causing startups to pivot after years of stagnation. **BMC-RID** robustifies the Business Model Canvas thanks to two RID advantages: (i) The canvas is initiated with the ambition perimeter, (ii) A set of **UNPC innovation indicators** is assigned to each of the nine BMC-RID blocks, each block being seen as an ideation space controlled by an innovation maturity index.

## Design Creativity

### Morphological Matrix

A morphological matrix is a powerful tool used to generate ideas by breaking down complex problems into smaller, more manageable elements. For each category of problem elements, it is possible to brainstorm its own solution elements. Any combination of solution elements for each category can then be considered an innovative solution architecture. RID takes inspiration from this approach at several points: (i) when **setting up the cognitive model**, where the problem is broken down into 4 dimensions with several categories, (ii) during the **two-stage PSO ideation process**, when the new activity scenario is derived from a combination of the results of the ideation sessions from the value buckets (see **scenario creativity**), (iii) idem for **concept creativity**.

### C-K Theory

The **RID observe/knowledge design** stage adopts another knowledge management style than **C-K** Theory's. Knowledge is collected in the boundary of a studied **activity**, driven by **user profiles**, **usage situations**, **performances and problems** along with their causes and consequences, and the **existing solutions** / **concepts**. RID ontology is rich(er) in representing a design situation. RID also encourages experimenting for uncovering deep knowledge items, which is here comparable to **C-K** practice. But innovation relevance is clearly defined in RID on the ability to alleviate people's pain as well as on the effectiveness of competing solutions.

### TRIZ

RID has been inspired by TRIZ **systematic search** for innovative concepts and **problem solving** approach. Indeed, the *ARIZ algorithm* is somewhat comparable to the 4-dimension RID segmentation, as it first consists in properly isolating where and when a contradiction happens, to get **qualified questions** for **ideation**.

## Industrial Engineering

### Systems Engineering

RID borrows several principles from SE: its systematicity, its model-based approach and its **metrics** and **decision-making algorithms** in the presence of complex systems.

### Value Analysis

The success of **Functional Analysis and Value Analysis** in engineering design stands in the facility to list a series of **functions** which are supposedly **expected behaviors** of the system by users. In addition, the targeted performance levels of these functions are in practice averaged for users. These two limitations are fixed with RID. Functions are banished from RID for being too artificial and interpretable by designers (see **UDIP model of designing**), we only record the levels of problems in given situations by the appropriate user profiles, with no abusive interpretation. And the RID process tries to alleviate at most the **quantities of pain**.

### Failure Modes, Effects and Criticality Analysis (FMECA)

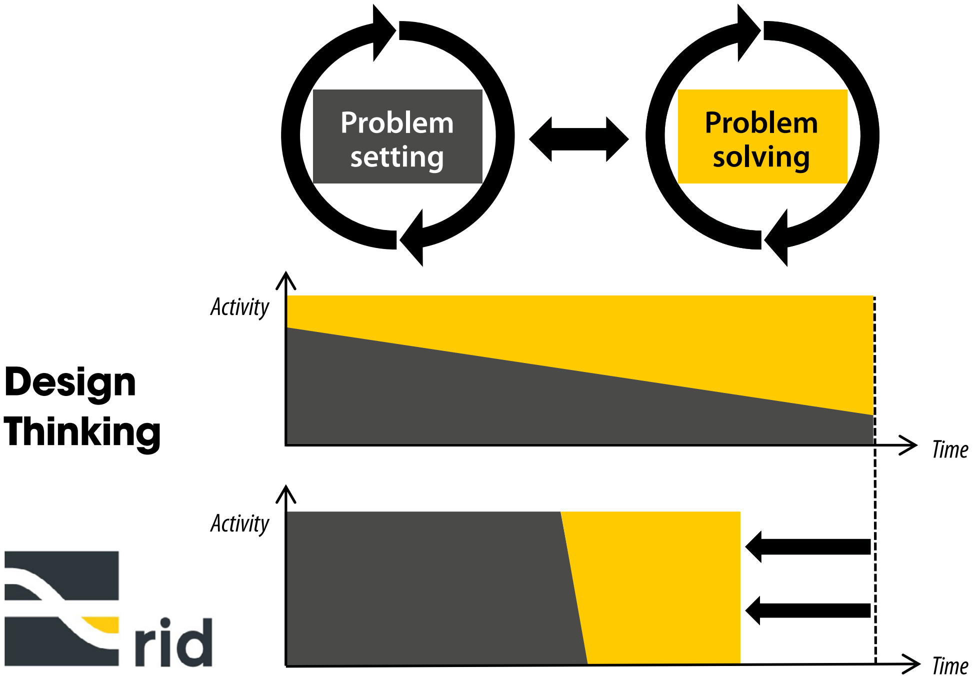
RID borrows from FMECA most of its concepts. First, RID **problems** are **failure modes** with **consequences** of different severities. The averaged **severity** and the **probability of occurrence** of a failure mode determine the problem **importance**. In addition, **causes** of problems are investigated and recorded as they are major innovation seeds during ideation stages for removing or lowering quantities of pain (see **RID creativity** method).

# Why and when to use RID?

## Time saving

Compared to traditional innovation, we observed that the RID process is 20% to 30% faster.

Indeed, in RID, the **problem setting** stage is more intense and goes into more depth than in Design Thinking. The disruption with **problem solving** is more pronounced and **design backward loops** are almost non-existent, as decisions have been made in an informed manner from the creation of a (complete) set of alternatives (see **set based thinking**).



## You understand your customers better

By modeling their activities, feelings, expectations and performance, and the effectiveness of competitors' solutions, you build a simulator of market expectations.

## You measure the value created by your solution

Real indicators to quantify the utility value (usefulness) created by your solution in its competitive universe.

## Better knowledge management

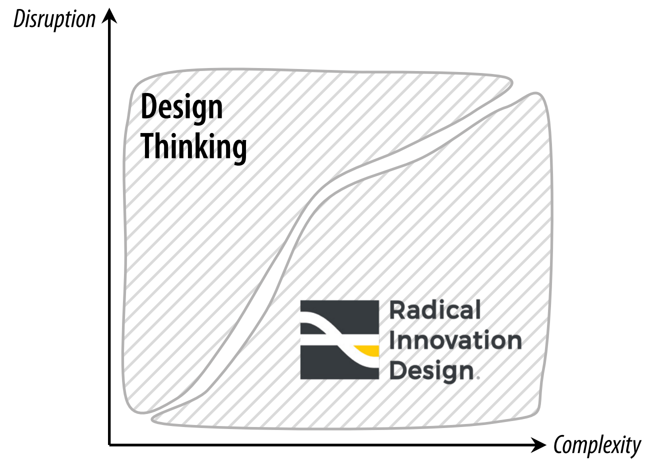
RID is more likely to generate reusable knowledge and intermediary outcomes for future projects.

## Better qualitative solutions

In 2013 (Yannou et al, 2013), we demonstrated by Bayesian learning on dozens of projects that RID structuring of the problem leads to a better quality of the solution. With fewer, but much more relevant ideas.

## Adapted to complexity

RID is adapted to complexity because of (a) its systemic approach (**activity field, ambition perimeter**), (b) its segmentation and set **based thinking approach**, (c) its algorithms and tools to select, prioritize and make decisions (**RID comparator, RID compass, UNPC monitor**). We observed that: the more complex the innovation challenge, the better RID is. Consequently, Design Thinking and RID are complementary.

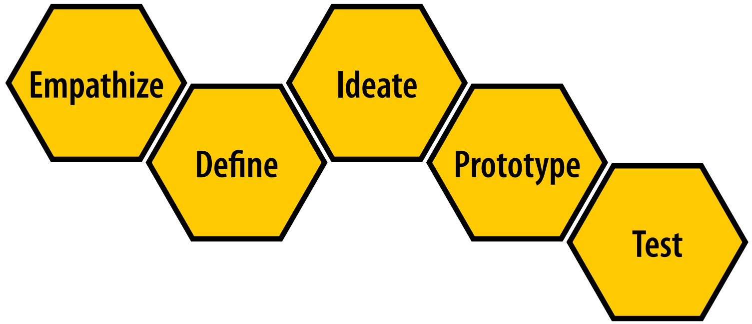



*SOURCE*

Yannou B., Jankovic M., Leroy Y., Okudan Kremer G.E., 2013. Observations from radical innovation projects considering the company context. *Journal of Mechanical Design, 135 (2).*

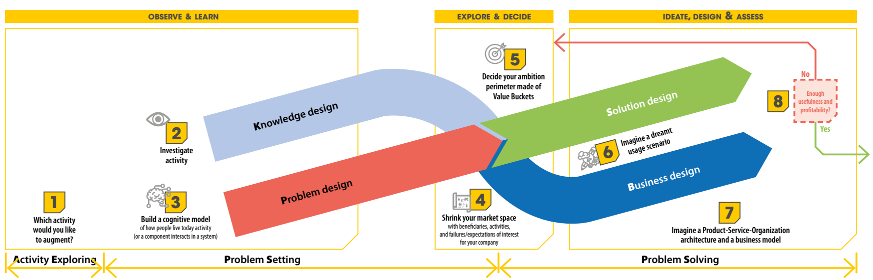
# 144 RID is an augmented Design Thinking process

**Design Thinking process**

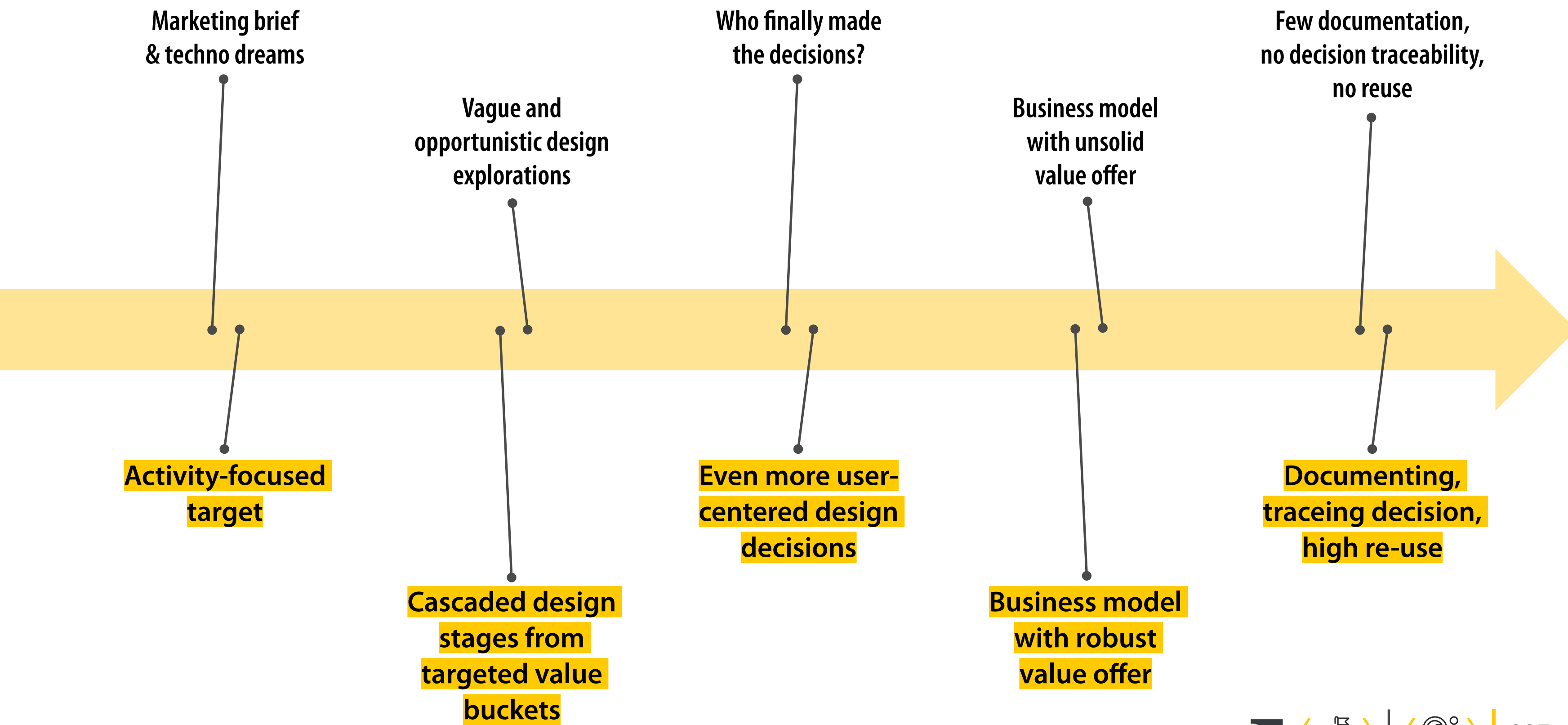



Sacrificed and shallow context setting

**Radical Innovation Design process**




Systematic and structured problem setting


Marketing brief & techno dreams
Vague and opportunistic design explorations
Who finally made the decisions?
Business model with unsolid value offer
Few documentation, no decision traceability, no reuse
Activity-focused target
Cascaded design stages from targeted value buckets
Even more user-centered design decisions
Business model with robust value offer
Documenting, traceing decision, high re-use

# 145 Unique selling propositions of RID

Radical Innovation Design® methodology has the advantage of (1) **integrating** a set of existing innovation methodologies into a homogeneous framework, (2) **improving** deficient aspects of existing methodologies, (3) presenting a series of **unique and exclusive selling propositions** that allow companies to support **need-seeker innovation** projects.

## Integration of existing methodologies

- **Design Thinking**
- **Kano** Analysis
- **Knowledge** mapping / mindmaps
- **Causal** analysis (FMECA, TRIZ, Ishikawa diagram)
- **Ethnographic** approaches (collection of insights, observation of situations, journey maps)
- **Business Model Canvas**
- **UX design**

## Improvements on existing methodologies

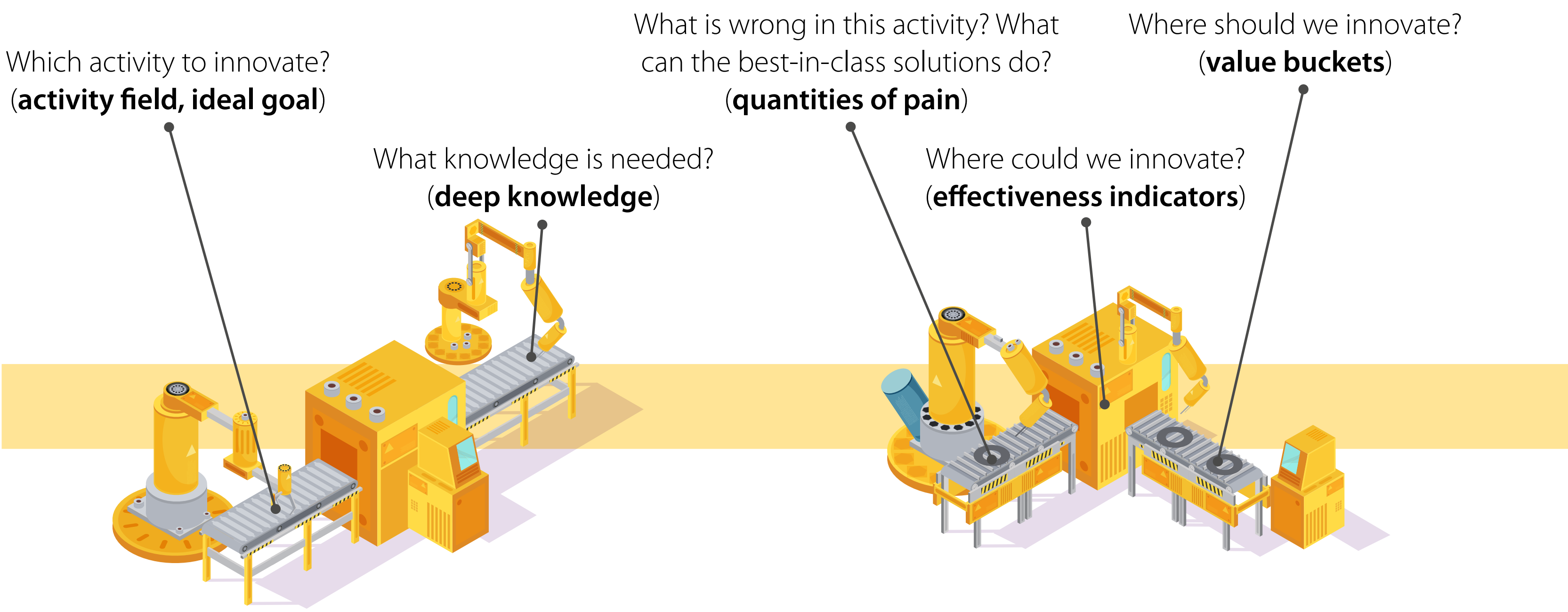
- More **structured design process** than Design Thinking's
- Approach deliberately driven by **usage** and centered on **activity**
- Organized and systematic **problem/solution** dialectic
- Enhanced monitoring of the **problem setting**
- **User profiling** rather than personas
- **Ideation in two distinct steps:** usage & UX (**scenario creativity**) and product-service architecture & business model (**concept creativity**)
- The "value proposition" of the BMC starts with the selection and maturation of value buckets (see **BMC-RID method**)

## Unique, exclusive propositions

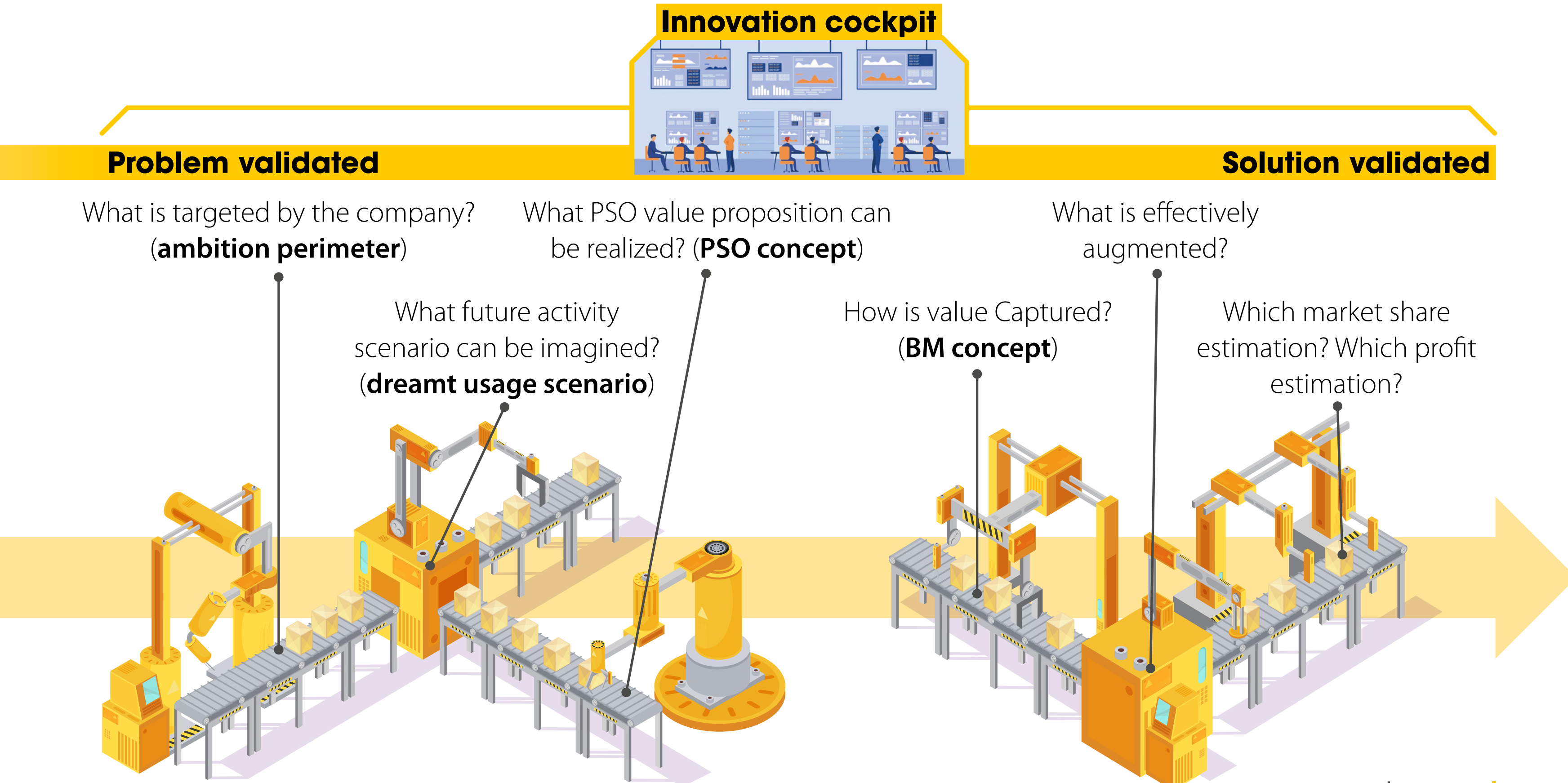
- **Systemic approach** from the activity field
- The concepts of "**quantities of pain**", "**effectiveness**" and "**value buckets**" **qualify and quantify** the innovation paths that are worth the effort; creativity is focused on qualified questions
- Matrix approach based on the **segmentation of 4 dimensions**: users x situations (of usage) x problems x existing solutions
- **Capitalization** and **systematic and progressive exploration** lead to an enhanced **traceability** of the innovation process
- **Usefulness** first, rather than "wow effect"

# 146 RID as a production process

**With RID, innovation becomes an observed, controlled and optimized production process; it is a systematic and informed process where a clear question is asked and answered at each stage.**



Two important milestones exist (i) when the problem is validated, and (ii) when the solution is validated. In between, a kind of digital intelligence, mainly made of RID comparator and RID compass, monitors the stage and gate of this production process. Note that when no satisfactory solution comes, the problem must be revisited. **In short, the RID process consists of the optimization of the (problem, solution) pair** thanks to the innovation cockpit made of the RID comparator and the RID compass..



# 147 RID behavioral charter

**When you are a member of a RID study,** here are 4 **ideal attitudes** to adopt for the success of the project:

1. **Dare to do, dare to experiment, give yourself the means**, for example, to maximize your awareness of the problem by putting yourself in fruitful investigative situations, or to explore a subset of different possible solutions to the same problem.
2. **Learn to hunt in a pack.** When you hunt in a pack, you avoid working separately without a shared plan, which leads to inefficiency. Instead, you work by sharing tasks, which allows you to explore more avenues, and you follow a common work plan orchestrated by the phases of a RID study. At each stage of RID, you also need to manage the multiple possibilities, investigate, take and chart the decision as a group to proceed.

3. **Be all accountable of the RID study results**, as if the final quality of the study depended solely on you. This solidarity will strengthen the coherence of the results of the study and the exploitation of all the avenues of innovation that you could have taken.


4. **Adopt the *Prove it!* attitude.** Don't be content with vague allegations, don't be satisfied with the hunches of a single smooth talker, but demand tangible evidence and help him/her and yourself to produce it (see **traceability**).

# 148 Traceability and *Prove it!* attitude

## Observation

The tragedy of innovation management in companies is that, because it is not considered to be a hard science, people take advantage of it to assert personal convictions - impressions, feelings or preferences - without any real basis. What's more, in the end we never know how we arrived at the final result, yet we are prepared to assert that this is one of the best solutions we could have found. Having no proof to back up the value of the final innovative solution, the company is rightly reluctant to commit more resources to launching the industrialization of the proposed solution. This lack of proof is due to the **lack of traceability** in the **exploration of the innovative design process (see Design Thinking in practice).**

## Being scientific in a design process means...

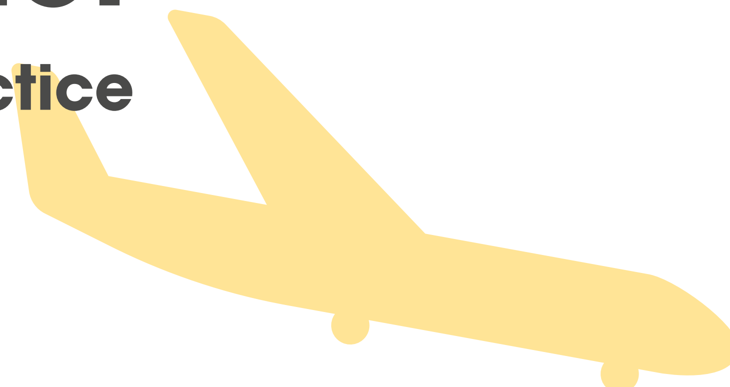
- Not just describing an innovative solution,
- Not just describing the path to an innovative solution,
- But describing the space explored or the set of possible paths, giving the reasons for the choice of path taken, and providing evidence of the value created by the innovative solution at the end of the path taken.

**The RID process and its integrated methods are designed to ensure traceability** of decisions made at every stage, so that a complete and credible story can be told at the end of the project that proves the value of the final solution and the process followed.

**The *Prove it!* attitude of the project members** at any moment helps to consolidate this traceability at every process stage.

# To go further

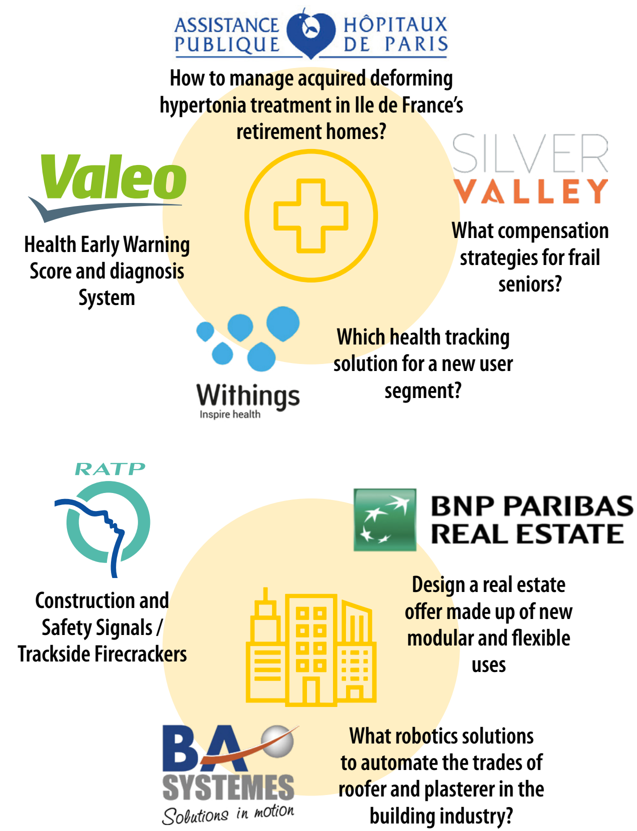
## Applying RID in practice



# 149 Examples of RID studies

**RID has been applied in all economic sectors.** By design, RID is particularly well suited to the BtoC (Business to Customer) sector, but it has quickly spread to the BtoB and BtoBtoC sectors, since there are a variety of non-trivial usage contexts, and it is necessary to study the suitability - or coverage - of an offer for these contexts in a competitive situation, or even when no offer exists.

**RID does not presume the nature of the resulting value proposition.** Whether the result is more of a product, a service or even an organization, the study is conducted in the same way, as long as the resulting solution makes it possible to improve the targeted activity.



SAIPEM
Exploration of port solutions for the maintenance of floating wind turbines

EDF
Explore the business potential of the concept of a healthy indoor environment for residential housing

Air Liquide
creative oxygen
Study of the use of gas cylinders among Air Liquide customers to innovate on their mobility

SUPRATEC
Securing the underground of large cities

twinlife
own your life online
Communicate and manage your privacy with confidence

SAFRAN
Capture runway information for flight safety and runway maintenance

THALES
IoT's contribution in Optronics applied to Reconnaissance and Surveillance missions

AMADEUS
Last minute refund, or flexibility in cancelling flight tickets

GROUPE RENAULT
New services for autonomous shared vehicles

Stanley Black & Decker
How can new IoT technologies improve productivity and customer service in a car garage?

angénieux
How can high-quality lenses compete with emerging webcam solutions?

INSTITUT VEDECOM
DU VÉHICULE DÉCARBONÉ ET COMMUNICANT ET DE SA MOBILITÉ
Negative externalities of delegated driving vehicles

faurecia
The connected car seat for the safety of the elderly

SystemX
INSTITUT DE RECHERCHE TECHNOLOGIQUE
How to develop mobility sharing solutions?

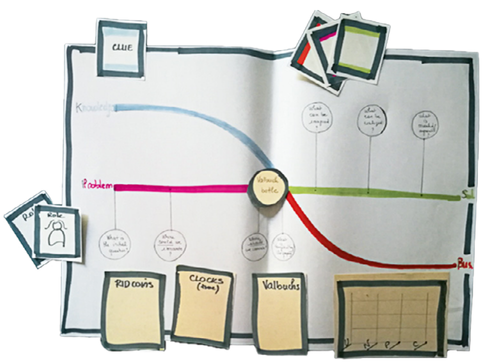
Valeo
Comfort of the electric and autonomous car

# 150 The RID serious game

**You can put into practice the basics in only 3 hours.**

## Narrative

Set the scene for mobility users in the Ile-de-France region, their daily usages and the dissatisfactions they experience depending on the means of transport used or available. The game script immerses learners in the complexity of contextualizing usage, which is a prerequisite for producing usefulness.



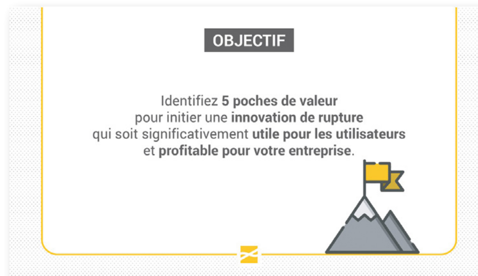

## Roles

RADICAL INNOVATION DESIGN SERIOUS GAME

TEMPLATE DOWNLOADABLE

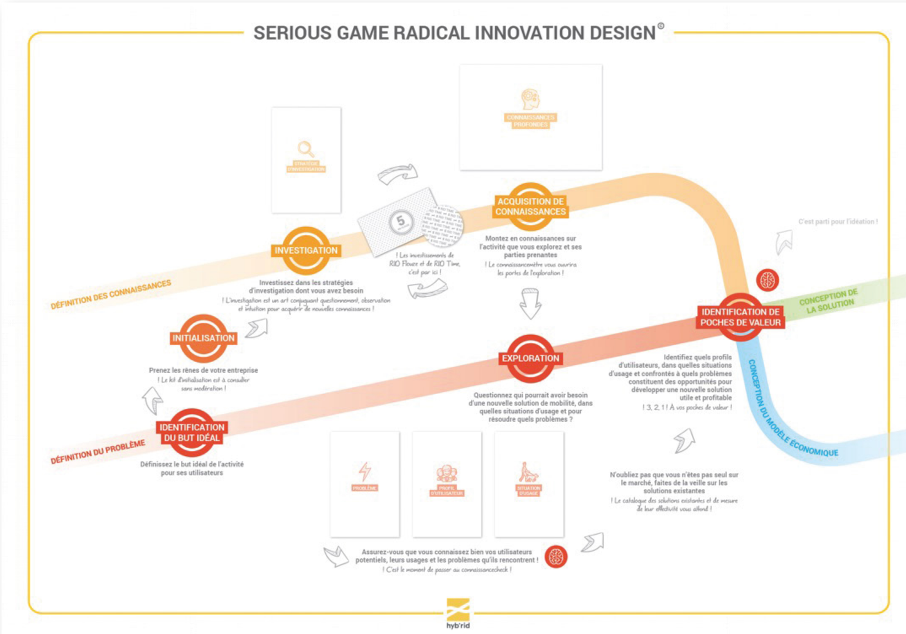

## Objectives

You have two contradictory objectives of **usefulness for users** and **profitability for your start-up.**



## Game board

## Just play, have fun, experience and debrief!



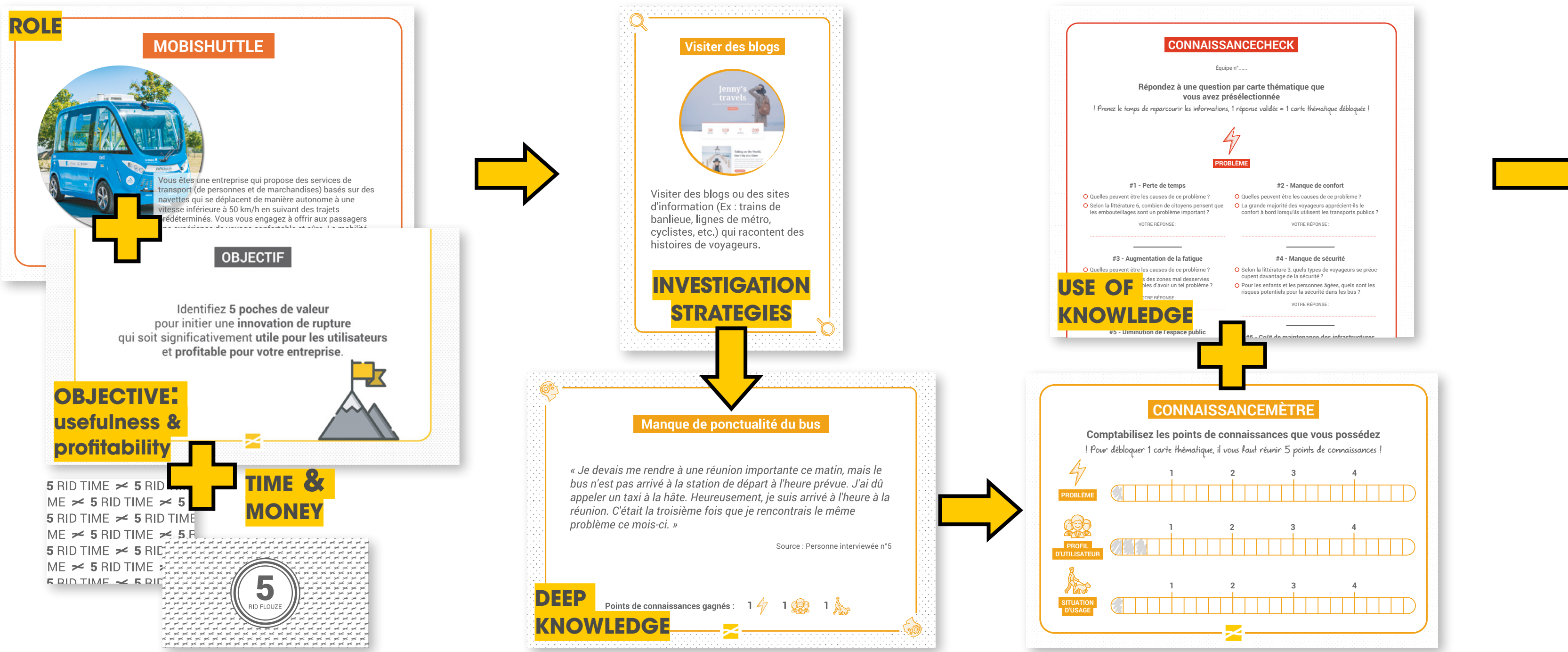

***SOURCE***

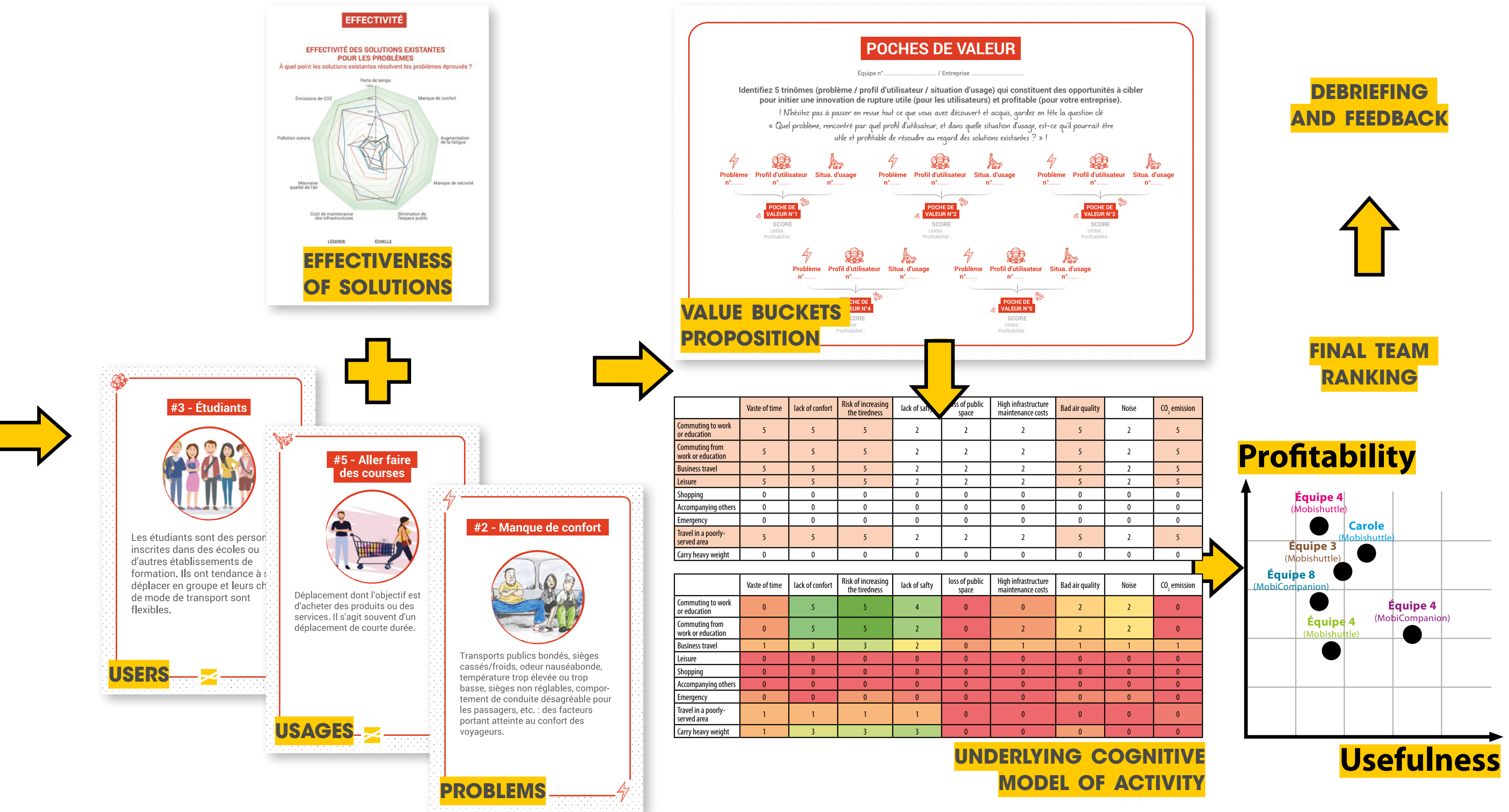
Ma, Y., Yannou, B., Cluzel, F., & Vallet, F. (2023). Tools to help teachers and designers complete individual tasks when co-designing industrial engineering games - Application to the design of an innovation management game. *European Journal of Engineering Education.*

Yannou, B., Vallet, F., & Cluzel, F. (2023, 5-7 juillet). Innover par les usages sur un périmètre d’activité: la méthodologie Radical Innovation Design illustrée par son jeu sérieux sur l’innovation de la mobilité sur le Grand Paris. Paper presented at the 12ème Colloque EPIQUE, Paris.

# 151 The RID serious game mechanics

The **RID Serious Game** was designed as a use case to illustrate a new method for designing serious games to teach industrial engineering methodologies.






| | Vaste of time | lack of confort | Risk of increasing the tiredness | lack of safty | loss of public space | High infrastructure maintenance costs | Bad air quality | Noise | $CO_2$ emission |
|---|---|---|---|---|---|---|---|---|---|
| Commuting to work or education | 5 | 5 | 5 | 2 | 2 | 2 | 5 | 2 | 5 |
| Commuting from work or education | 5 | 5 | 5 | 2 | 2 | 2 | 5 | 2 | 5 |
| Business travel | 5 | 5 | 5 | 2 | 2 | 2 | 5 | 2 | 5 |
| Leisure | 5 | 5 | 5 | 2 | 2 | 2 | 5 | 2 | 5 |
| Shopping | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Accompanying others | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Emergency | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Travel in a poorly-served area | 5 | 5 | 5 | 2 | 2 | 2 | 5 | 2 | 5 |
| Carry heavy weight | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | Vaste of time | lack of confort | Risk of increasing the tiredness | lack of safty | loss of public space | High infrastructure maintenance costs | Bad air quality | Noise | $CO_2$ emission |
|---|---|---|---|---|---|---|---|---|---|
| Commuting to work or education | 0 | 5 | 5 | 4 | 0 | 0 | 2 | 2 | 0 |
| Commuting from work or education | 0 | 5 | 5 | 2 | 0 | 2 | 2 | 2 | 0 |
| Business travel | 1 | 3 | 3 | 2 | 0 | 1 | 1 | 1 | 1 |
| Leisure | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Shopping | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Accompanying others | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Emergency | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Travel in a poorly-served area | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| Carry heavy weight | 1 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 |

***SOURCE***

Ma, Y. (2021). *Design of serious games for teaching industrial engineering methodologies: A design process based on V-model and an application in innovation engineering.* (PhD thesis), Université Paris-Saclay.

# 152 RID training & certification levels

There are **four levels of certified training**. These certifications are issued by CentraleSupélec, a major teaching and research establishment and owner of Radical Innovation Design methodology. Choose your training formula:

- If you're looking for traditional, inter-company training, contact **CentraleSupélec Executive Education**, the professional continuing education centre for managers.
- If you would like training tailored to your company, your sector of activity or your project, contact **HyB'RID company**.

CentraleSupélec EXED

HyB'RID

### The RID serious game: a flexible progression towards RID expertise

Set the scene for mobility users in the Ile-de-France region, their daily usages and the dissatisfactions they experience depending on the means of transport used or available. The game script immerses learners in the complexity of contextualizing usage, which is a prerequisite for producing usefulness.

## Certification levels & contents of the training sessions


**Novice RIDer** training is a one-day discovery of RID principles and its unique process, by serious gaming and experience sharing. Upon completion, you are able to participate in a RID project.


**Easy RIDer** training puts in practice the method on main modelling stages of the four sub-processes. Upon completion, you are able to take on responsibilities during a RID project.


**Advanced RIDer** training includes an application of RID methodology on your own, starting from an initial idea in the context of your company or a personal project. Upon completion, you are able to specify, size and launch a RID project.


**Expert RIDer** training adds coaching by a RID master following up a RID project that you launch and manage in your own company. Upon completion, you are able to fully manage a RID project in real conditions and to train collaborators for Novice-RIDer and Easy-RIDer certifications.


**Master RIDers** are RID founders and long-term experts co-opted by RID founders, who contribute to RID methodological developments.

# 153 HyB'RID company

Radical Innovation Design.

CentraleSupélec

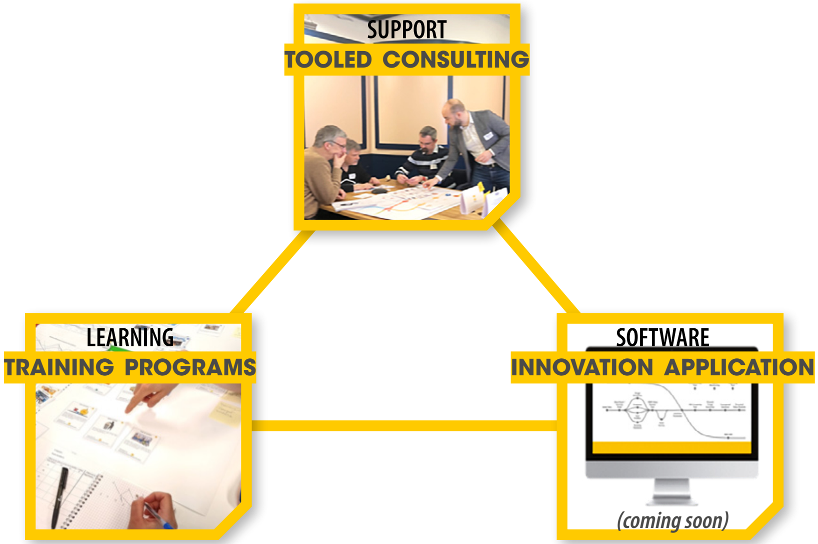
université PARIS-SACLAY

**METHODOLOGY**

hyb'rid

**CONSULTING COMPANY**

Support for change management, differentiation strategy and solution design




Awareness-raising and training in systematic, usage-driven innovation

Exploration, Evaluation & Design of differentiating solutions

## HyB'RID offers three types of services to companies

You need to strengthen the development of your technology or PSO* solution...

You wish to target customers, usages, activities or pains and expectations with an innovative solution …

**Assess the maturity level** of your technology/solution
**Identify the activities** that your technology/solution could **impact**
**Measure the potential** of your technology/solution in relation to the **targeted markets**
**Build your technology-market roadmap**

**Understand the stakes** of the customers, the uses, the activities or the targeted pains/expectations
**Identify the value buckets to target** pains and expectations not met by existing solutions in a potential market
**Build the specifications of your new product/service/organization**

**Design the architecture** of your innovative product/service/organization and **its business model**
**Assess and validate** the augmented activity and the corresponding competitive advantage
**Build the disruptive offer solution and assess the differentiating value created**

*Product, Service and/or Organization

# 154 RID exercise booklet

Once you think you have acquired the fundamentals of Radical Innovation Design, you can practice by downloading an **exercise booklet**.


TEMPLATE DOWNLOADABLE

You will also find the **corrections for these exercises**.

TEMPLATE DOWNLOADABLE

# Appendices

## For additional theory

# 155 RID is a quadruple-diamond process

RID has extended the **double-diamond design process** - created in 2005 by the UK Design Council - into a **quadruple-diamond process** made of two first parallel **exploration-exploitation** of the **knowledge** and **problem design**, followed by two parallel **exploration-exploitation** of the (PSO) **solution** and **business** (model) **design**.

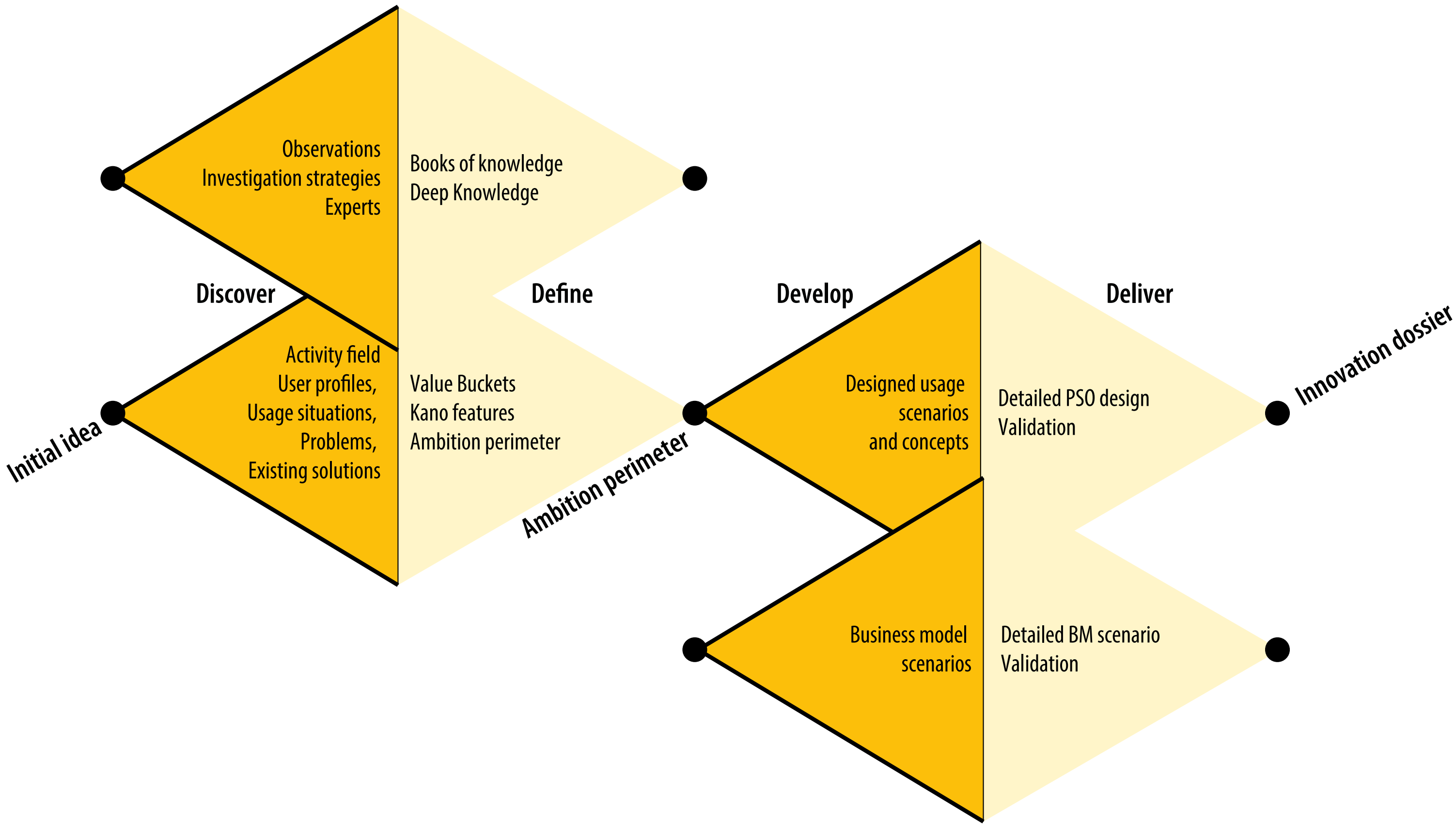
The gap between the diamonds in the middle traditionally corresponds to the *innovation specification or design brief*. With RID, it corresponds to the **books of knowledge** and the **ambition perimeter**.

The deliverables at the end of the Quadruple Diamond are gathered in an **innovation dossier** and are made of:

- **A detailed and validated PSO design solution**
- **A detailed and validated business model scenario**
- **All the study documentation to ensure traceability of decisions** made at every stage - so that a complete and credible story can be told at the end of the project that proves the value of the final solution and the process followed.

## RID process (in the double-diamond template)

RID matches the Double Diamonds template and even extends it with four diamonds corresponding to the four sub-processes: **Knowledge design, Problem design, Solution design, Business design**.

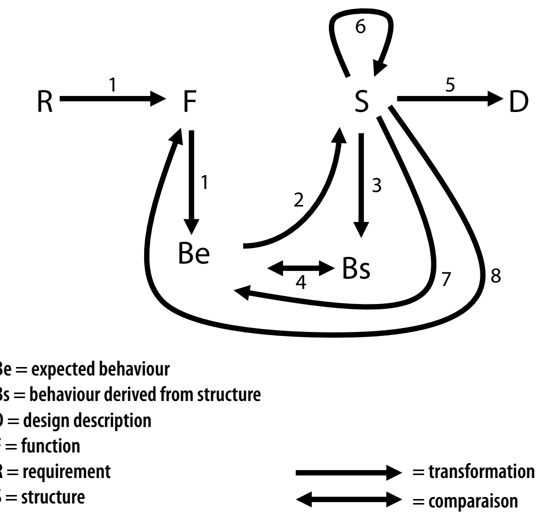


# 156 A novel innovation language: the UDIP model of designing

While the **FBS model of designing** [1] is recognized to be a useful framework for representing and analyzing design methods, the **UDIP model** [2] is an evolution of the FBS framework that better embraces the specifics of usage-driven innovation processes such as RID methodology. The **UDIP model**, which significantly differs from the FBS model, is better adapted to the front-end of innovation. The validation of the final design by comparing the revealed value buckets with the targeted value buckets is a significant advance.

## FBS model of designing by John Gero

The **Function-Behavior-Structure (FBS)** "model of designing" by John Gero **[1]** is a framework for analyzing design methods. The FBS model describes the act of designing with **6 design issues (constructs)** and **8 fundamental design processes** linking these design issues in a generic design process.



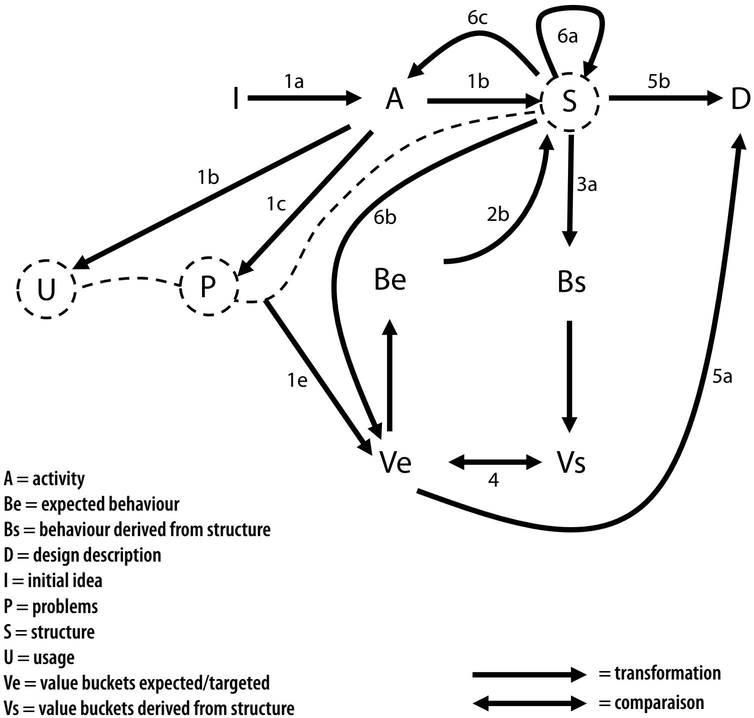

Be = expected behaviour
Bs = behaviour derived from structure
D = design description
F = function
R = requirement
S = structure

## UDIP model of innovating by RID

The **Usage-Driven Innovation Processes (UDIP) model [2]** is a framework for analyzing innovative design methods. The UDIP model describes the act of innovating with **10 design issues (constructs)** and **15 fundamental design processes** linking these issues in a generic innovation process. Important evolutions of the FBS model incorporated in UDIP include:

- **R** (requirements) and **F** (functions) are banished from RID for being too artificial and interpretable by designers.
- **I** (initial idea), **A** (activity field), **U** (usage), **P** (problems), **Ve (expected/targeted value buckets)** and **Vs (value buckets derived from structure or revealed)** are introduced to enrich the traditional "task clarification".

The comparison is no longer between Be and Bs, but between Ve and Vs, i.e. expected and revealed value buckets.




***SOURCE***

[1] Gero, J. S., 1990, "Design prototypes. A knowledge representation schema for design," AI Magazine, 11(4), pp. 26-36.

[2] Yannou B., Lamé G., Cluzel F., 2018. Adapting the FBS model of designing for usage-driven innovation processes, *In IDETC/CIE 2018: International Design Engineering Technical Conferences / CIE: Computers and Information in Engineering, August 26-29, Quebec City, Quebec, Canada.*

# 157 Humanism and essential values

RID, in accordance with **Jeremy Bentham's utilitarianism**, defines "**usefulness**" of a solution as its ability to improve the well-being of humans to reduce their pains and to meet their expectations in different situations. It demonstrates a **humanistic philosophy of innovation**, while creating essential values for users, as well as for social life. These values are qualified and quantified by **value buckets** in RID and assessed by **UNPC innovativeness indicators**.

## Other humanistic values

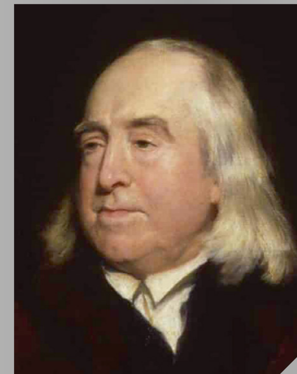
The positive values of **Maslow's pyramid** can also inspire the essential values that govern an activity that aims to improve. The principle of **usage coverage** developed by the authors [1], or **Prahalad's Bottom of the Pyramid (BoP) principles** [2] may also be represented in RID value buckets, as well as the frugality principle of **Radjou et al.'s Jugaad innovation** [3], or **eco-innovation** and **sustainable design** principles [4].

## Essential values of RID

| Innovation is motivated by… | Design solution is … | Type of need |
|---|---|---|
| **Essential needs** | Useful | ▪ Lowest levels of Maslow's pyramid, like eating, drinking, health, safety, or linked to significant psychological suffering, like a mood disorder such as depression or bipolarity, loneliness, difficulty of living in society, socialization, self-esteem. |
| **"Non-essential", trifling or frivolous needs or curiosity** | Superfluous | ▪ Some higher levels of Maslow's pyramid, like buying a luxurious fragrance or watch, or the latest mobile phone or sports car, may be considered as superfluous.<br>▪ Outside Maslow's pyramid like "acquiring a weapon to kill someone" – non-humanistic need – or "giving in to the compulsion to follow fashion" – neurosis.<br>▪ Human curiosity as well may explain a certain fascination for robots or new technology. |

***SOURCE***
[1] Bekhradi A., Yannou B., Farel R., Zimmer B., Chandra J., "Usefulness Simulation of Design Concepts", *Journal of Mechanical Design vol. 137, n° 7.*
[2] Prahalad C.K., 2005. *The Fortune at the Bottom of the Pyramid. Wharton School Publishing, ed. Pearson, New Jersey: Upper Saddle River,* ISBN: 978-0-1314-6750-7.
[3] Radjou N., Prabhu J., Ahuja S., 2012. *Jugaad Innovation: Think Frugal, Be Flexible, Generate Breakthrough Growth, San Francisco, USA: Jossey-Bass,* ISBN: 978-1-1182-4974-1.
[4] Flore Vallet, Benjamin Tyl, François Cluzel, Yann Leroy. Research directions in eco-innovation: a French perspective. *International Journal on Interactive Design and Manufacturing*, Springer Verlag, 2016, 10 (3), pp.309-318.

**Jeremy Bentham**



RID, consisting of **maximizing the total usefulness value** (targeting **"jobs-to-be-done"** problems) for people in different **usage situations**, is compatible with Jeremy Bentham's utilitarianism which aims to do good for the greatest number of people.

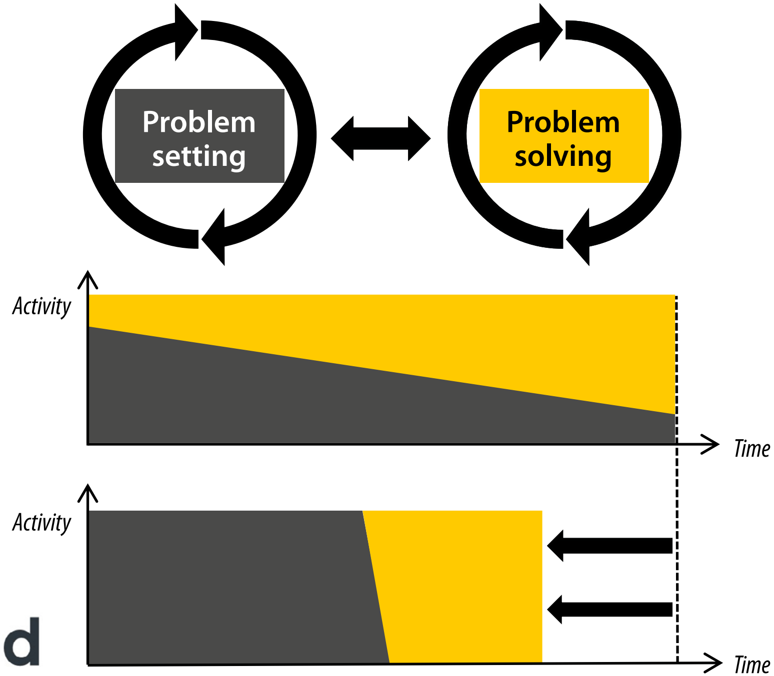
# 158 Problem and solution co-evolution

The literature of design engineering describes a natural innovation process as a **dialogue between problems formulations and solutions descriptions**. An organized innovation process may even stimulate creativity. Herbert Simon was the first to theorize a design process with a preliminary **problem setting** stage. RID, in turn, recommends that **problem setting** precedes **problem solving**, without constraining the search space and limiting **creativity**, but in **shorter lead times**.

## In literature

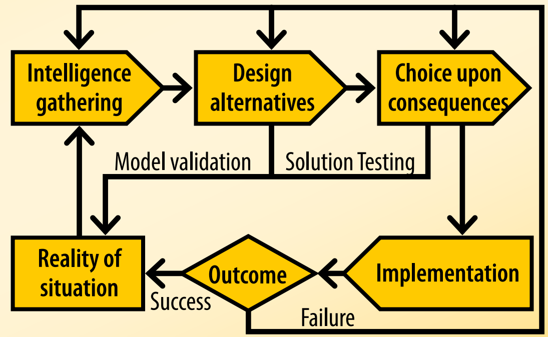
*"Maher and Poon (1996) and Dorst and Cross (2001) describe a design process as an alternation between relevant questions and answer exploration for the designer. This co-evolution model of design explains the developing relationship between the "problem space" and the "solution space"; there is, according to them, a close correlation with the occurrence of design creativity as it has also been shown by Wiltschnig et al. (2013). However, most innovative design processes are practically described as a sequence of problem identification, ideation and solution design; let us mention Design Thinking, Radical Innovation Design (Yannou et al, 2016), Blue Ocean Strategy (Kim & Mauborgne, 2005), Business Model Canvas (Osterwalder et al., 2014). Kruger and Cross (2006) show that using a problem driven design strategy tends to produce the best results in terms of the balance of both overall solution quality and creativity."* from (Al Maghraoui et al., 2019)

**Design Thinking**




## Simon's decision / design process

The three stages in Rational Decision Making: Intelligence, Design, Choice (IDC)




***SOURCE***

Dorst, K., & Cross, N. (2001). Creativity in the design process: co-evolution of problem–solution. Design Studies, 22(5), 425–437.
Kruger, C., & Cross, N. (2006). Solution driven versus problem driven design: strategies and outcomes. Design Studies, 27(5), 527–548.
Maher, M. L., & Poon, J. (1996). Modelling design exploration as co-evolution. *Computer-aided civil and infrastructure engineering*, 11(3), 195–210.
Wiltschnig, S., Christensen, B. T., & Ball, L. J. (2013). Collaborative problem–solution co-evolution in creative design. Design Studies, 34, 515-542.
Al Maghraoui O., Puchinger J., Vallet F., Yannou B., 2019. Stimulating usage problem generation: An urban mobility case study. Design Studies, 64, 27-63.

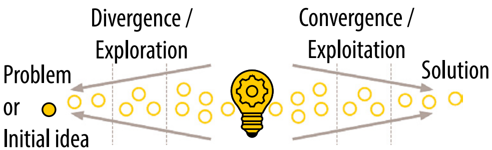
# 159 Exploration - exploitation

A practical **innovation process** is often compared to an **innovation funnel** of ideas which must be monitored (see **SAPIGE®**) for a relevant ideas attrition. But this funnel is also depicted as a series of **exploration** steps, i.e. divergent stages of idea production, and **exploitation** steps, i.e. **convergent** stages of idea selection, refinement and hybridization. This is another way to represent the **problem and solution co-evolution**. The number of exploration-exploitation cycles is variable; the RID process follows a **quadruple-diamond** shape.

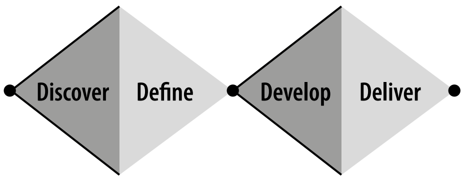
## An enhanced exploration-exploitation with RID

The "**set-based thinking**" and "**thinking inside the box**" principles of RID ensure an enhanced **exploration-exploitation** of the user activity "box" guided by the initial idea.

## Multiple representations

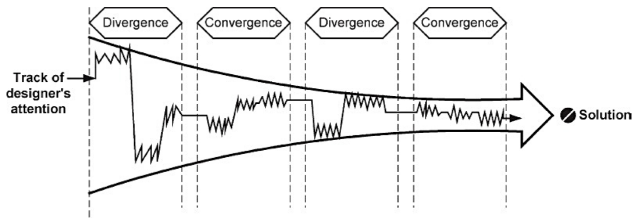



After **Betoluci et al. (2013)**, the representation of an elementary exploration-exploitation cycle

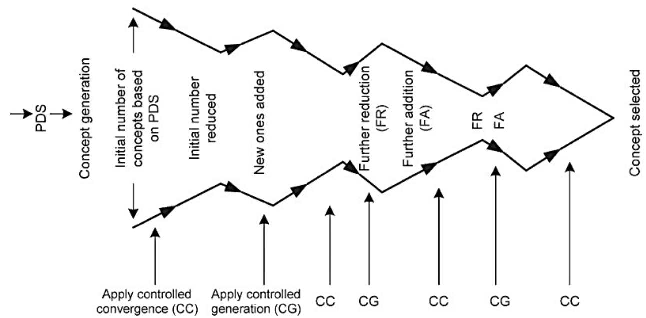


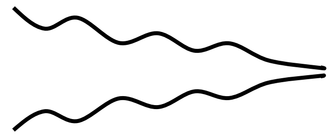

After **UK Design Council (2005)**, the innovative design process follows two exploration-exploitation cycles: a **Double-Diamond**.

After **Millier (1999)**, an "Ideal" funnel development is a series of inspirations and expirations.




After **Pugh (1990)**, concept generation and evaluation are organized in a progressive and disciplined manner.



After **Cross (1994)**, the conceptual design process is mostly convergent, while needing to incorporate a deliberate divergence in the search for novel ideas.


**SOURCE**

Cross N., "Engineering Design Methods - Strategies for product design", Wiley & Sons, Chichester, 1994, ISBN: 978-1-1197-2440-7.

Millier P., Marketing The Unknown: Developing Market Strategies For Technical Innovations, Wiley & sons, 1999, ISBN: 978-0-4719-8621-8.

Pugh S., "Total Design: Integrated methods for successful product engineers", Addison Wesley, 1990, ISBN: 978-0-2014-1639-8.

For Double-Diamond concept, see UK Design Council website: https://www.designcouncil.org.uk/

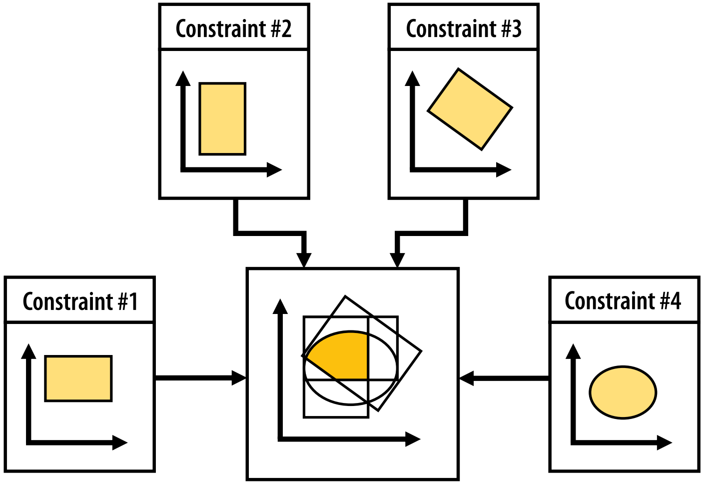
Bertoluci G., Yannou B., Attias D., Vallet E., 2013. A categorization of innovation funnels of companies as a way to better make conscious agility and permeability of innovation processes, In ICORD: 4th Int. Conf. on Research into Design, January 7-9, Chennai, India.

# 160 Set-based thinking

RID perfectly follows **set-based thinking** (SBT) principles. SBT is an organizational approach to frontloading the product development process to ensure the shortest time to market [3]. It is based on thorough problems investigation and preparation of sets of options, each option being considered along with its imposed constraints and consequences on solution space shrinking. Set-based design is considered to be the reason for the success of Toyota's development system in the 1980's, having ideally regulated the concurrent engineering [4,5] and its conflicting constraints. Constraint programming techniques have been used in Design Engineering for mathematical problem solving [1,2,7].

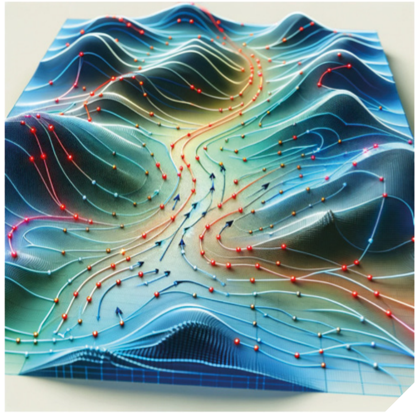
## Set-based design

**Set-based design** involves superimposing the design constraints to update the representation of the solution space. There are **no or few feedback loops**, as there is no adoption of an arbitrary solution, but a continuous **uncertainty reduction**. This principle, chosen by RID, is well adapted to **innovation funnels**.



## Point-based design

**Point-based design** consists of the iterative convergence of a variable solution point to a final stable solution. The classical solving technique is **Gradient Optimization**. The quality of the final solution depends on the quality of the initial points (ideas). The typical method is **Design Thinking** which needs numerous **feedback loops** to converge.



## Set-based thinking in RID

RID perfectly follows SBT principles (1) when transforming the initial idea into an ambition perimeter and even (2) during further ideation.
Indeed, the initial idea is enlarged into an ideal goal to consider more options and a more legitimate box. Next, this box is populated by existing usage situations and solutions during the problem design stage (see also [6]). This exploration-exploitation cycle corresponds to the first of the four diamonds of the RID process.


***SOURCE***

[1] Canbaz B., Preventing and resolving design conflicts for a collaborative convergence in distributed set-based design PhD Doctorate, Ecole Centrale Paris, Laboratoire Génie Industriel, 2013.
[2] Canbaz B., Yannou B., Yvars P.-A., 2014. Improving Process Performance of Distributed Set-based Design Systems by Controlling Wellbeing Indicators of Design Actors. *Journal of Mechanical Design, 136 (2).*
[3] Kennedy M.N., Harmon K., Minnock E., 2008. *Ready, Set, Dominate: Implement Toyota's Set-based Learning for Developing Products and Nobody Can Catch You Oaklea Press,* ISBN: 978-1-5116-5965-9.
[4] Sobek, D.K., Ward, A.C., Liker, J., 1999. Toyota's Principles of Set-Based Concurrent Engineering. Sloan Management Review 40, 67–83.
[5] Ward A.C., Liker J.K., Sobek D.K., Cristiano J.J., 1994. Set-based concurrent engineering and Toyota, *In DETC'94: ASME / Design Engineering Technical Conference, Sacramento, California, pp. DETC94/DTM, 79-90.*
[6] Yannou B., Moreno F., Thévenot H., Simpson T.W., 2005. Faster Generation of Feasible Design Points, *In DETC/DAC: ASME Design Engineering Technical Conferences, Sept. 25-28, Long Beach, CA, USA, pp. DETC2005/85449.*
[7] Yannou B., Harmel G., 2005. Use of Constraint Programming for Design, *In Advances in Design, ElMaraghy H., ElMaraghy W., eds. London: Springer-Verlag, Chapter 12, 145-155.*

# 161 Thinking inside the box

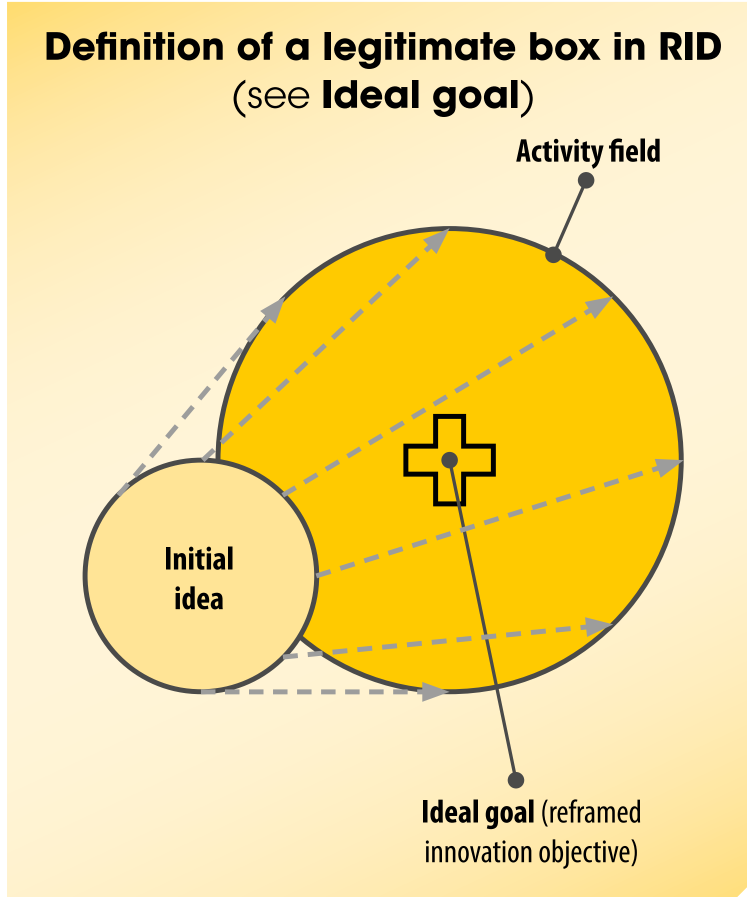
Instead of the traditional creativity motto thinking outside the box, RID recommends **thinking inside the box**, provided the box is large enough and well defined. This avoids the fixation effect in set-based thinking approaches, preventing pollution by early ideas that are too precise. In addition, the delimitation of a legitimate box by reframing the initial idea into an ideal goal defined by the clear boundaries of the user activity, greatly encourages being creative under justified constraints.

### Thinking outside and inside the box

In creativity, the urgent need for "thinking outside the box" is repeated everywhere, as if starting with a brilliant idea of innovation could be the solution during the **fuzzy front-end of innovation**. For instance, the frequency of search engine requests on the Internet is ten times less for "thinking outside the box" than "thinking inside the box". There is a lack of thinking frame which is criticized by some people and which causes the **fixation effect**.

## The fixation effect

The **fixation effect** is a well known psychological effect where you get stuck on initial ideas you had or the group had first. But your initial ideas have no reason to be perfectly expressed. They must always be challenged in order to improve their legitimacy.




**SOURCE**
Purcell A.T., Gero J.S., 1996. Design and other types of fixation. *Design Studies, 17 (4), 363-383.*

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# Radical Innovation Design

A systematic and usage-driven innovation methodology to ensure usefulness for users and profitability for companies

Bernard Yannou
François Cluzel

Would you like to revisit some preconceived ideas on how to lead innovation processes?

In a data-rich world, data analytics should reveal essential challenges to innovation and model the effectiveness of potential solutions. A robust innovation methodology should refer to leading market solutions, constructing its innovation brief upon a comprehensive user experience analysis. To determine how well solutions satisfy a range of user needs, more sophisticated methods are required to qualify user experience and quantify its expected benefits and notable shortcomings. Once we have pinpointed the pertinent problems, assistance in organizing ideation processes would be beneficial, fostering the development of promising concepts and business models, as well as swiftly appraising the practical efficacy of innovative solutions. There should ultimately be an openness to automating, to some degree, the articulation of pertinent issues and the curation of the most useful and profitable solutions.

Whether you share these convictions or are simply intrigued about innovation, this eBook is for you, as it shows how to innovate in an organized, modern way using the Radical Innovation Design® (RID) methodology. RID, a revolutionary computerized approach to knowledge- and usage-driven innovation, excels at the in-depth exploration and exploitation of problems and solutions and has proven its effectiveness in a wide range of industries. Aimed at professionals new to innovation, students and innovation experts alike, it offers three customized journeys to explore original concepts using practical illustrations and real-life projects.

The authors, Bernard Yannou and François Cluzel, are both design and innovation engineering faculties at CentraleSupélec, Université Paris-Saclay, and have extensive teaching experience. With a long list of industrial design and innovation books to their credit, they have supervised numerous doctoral theses in industrial environments. This eBook and related downloadable material are open-access to disseminate RID-based practices.

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