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Citizen Frugal Innovation: Insights From International Open Innovation Challenges With Underrepresented Groups of Society

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ABSTRACT

FRANCIS runs Open Innovation challenges for Citizen Frugal Innovation, i.e. frugal innovations by citizens for citizens. The two challenges of the project have been completed now. The paper presents the learnings.

Keywords: Frugal innovation, Citizen science, Open innovation

INTRODUCTION

The EU-funded FRANCIS (www.francis-project.eu) explores the power of Citizen Frugal Innovation (CFI), i.e. the combination of Frugal Innovation and Citizen Science. It does so to bridge the gap between industry and society in an effort to deliver simple, affordable and sustainable solutions that are in line with the needs of groups in society that are often underrepresented in today's research and innovation initiatives.

Frugal Innovation (FI) involves creating cost-effective solutions particularly for resource-constrained settings (Bhatti & Ventresca, 2013). The approach has become essential in developing countries and is increasingly relevant in developed nations, where organizations aim to cut costs, enhance sustainability, and connect with underserved markets (Tiwari & Herstatt, 2014). Prominent examples include the GE Vscan[1], a pocket-sized handheld ultrasound scanner, and Daan Technologies Bob[2], a

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[1]Product website: https://vscan.rocks/

[2]Product website: https://daan.tech/en/discover-bob-mini-dishwasher/?dt_cn=en

small mobile dishwasher. Frugal innovation also excels in the service industry, as demonstrated by the Aravind Eye Hospitals, a chain of eye care clinics[3] that ensure high-quality treatment even for patients with very limited or no financial means. While Frugal Innovation often is a way for companies to enter new, cost-sensitive markets, it is also sometimes the result of everyday people trying to find a solution for a problem that they have themselves or see in their proximity, i.e. amongst friends and family. Links between these two groups of frugal innovators, the corporate and the grassroots, are usually limited. FRANCIS aims to create synergies by supporting bottom-up frugal projects that are mentored by industry.

The increased importance of Citizen Science (CS) stresses the importance to empower grassroots frugal innovators, and provides valuable insights for the success of doing so. CS is broadly defined as the involvement of individuals in scientific processes without formal ties to scientific institutions (Buerger schaffen Wissen, 2016, 13). It encompasses various forms of participation in scientific knowledge production (Hacklay et al., 2021-a, 3), ranging from contributors and collaborators to project leaders who play meaningful roles in their initiatives (ECSA, 2015). CS thrives across multiple scientific disciplines, offering numerous benefits to researchers, society, and policymakers alike (European Commission, 2020, 64). It can enhance policy decision-making and contribute to the democratization of research (Hecker et al., 2019, 1).

Citizen Frugal Innovation (CFI) combines the strengths of both disciplines, utilizing the collective creativity of citizens to develop impactful solutions through collaborative innovation challenges (Antuña Rozado et al., 2022). FRANCIS seeks to involve diverse citizen groups, especially from underrepresented communities, to leverage their unique perspectives and experiences. This inclusive strategy guarantees that the solutions created are not only effective but also address the specific needs of a wider population.

The first of the two FRANCIS challenges was completed in 2023, the second one in 2024. The team of FRANCIS presented interim findings of the first challenge in an iSCSi publication (Wohlfart et al., 2024a) and highlighted planned changes of the second one in a publication presented at the 2024 AHFE conference in Nice, Italy (Wohlfart et al., 2024b). This paper offers a short overview on both challenges, along with their similarities and differences, to then highlight the project's overall findings on how to succeed in CFI.

Note: Fraunhofer's Artificial Intelligence agent FhGenie helped to improve the writing style of this paper.

THE TWO FRANCIS CHALLENGES

Both challenges included three rounds. The first round was open to everyone worldwide with an age of eighteen years or more. It invited people to send in ideas for innovative solutions. The first challenge did so based on a set of slides; the second one used a short online form. Both challenges offered

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[3]Company website: https://aravind.org/

ideation sessions to get started. The second round helped a group of selected teams to develop their ideas into concepts, supported by innovation methods. A small number of teams (five to six) were invited to the last round that aimed at improving the concept and adding a simple demonstrator. These last teams presented their prototypes in a final online event, where the solutions were ranked. Financial support was given to the teams of round two and the final round in the first challenge; the second challenge only offered a grant to the five final teams.

The First Challenge: Household and Kitchen

The first FRANCIS challenge targeted kitchen and household solutions for India, Germany and Turkey. Bosch Home Appliances Turkey was the industry coach. These were the groups the challenge aimed for:

- Troubled families: Individuals, who are part of a family of at least two people living together, with one family member in need of special care, for example because of low or high age (children, senior citizens) or a disability, and that feel restricted in budget and space.
- Green minimalists: Individuals, who have a modest lifestyle by choice or force, for example because they value simplicity or have restricted financial means, and aim at fostering ecological and social sustainability.
- Independent senior citizens: Elderly individuals and couples, who consider themselves senior citizens, live on their own or with friends/family, and manage their own household.

The following table shows two of the six finalist projects. Details on these and the other finalist projects can be found on the challenge website[4].

Table 1: Overview on the finalist projects – first challenge.

Name	Details
Despunte	A kitchen furniture solution for individuals, especially students and budget-conscious families, living in confined spaces. The high-quality, modular shelving can be customized to fit specific space requirements accompanied by an app for planning and assembly.
Holle	Holle is a user-friendly, unobtrusive device designed to facilitate making the bed. It addresses the challenge posed by large mattresses and sheets, especially for individuals with limited physical abilities. Once installed, a simple pulley mechanism tugs the sheet over the mattress edges, making bed-making easier for everyone.

The Second Challenge: Hotel, Travel and Outdoor Experiences

The second FRANCIS challenge focused on enhancing hotel, travel, and outdoor experiences in India, Germany, and Colombia. The challenge was hosted by the FutureHotel network, a consortium of hospitality industry

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[4]https://s.fhg.de/francis-challenge

companies managed by Fraunhofer, alongside Globetrotter, a leading international provider of outdoor equipment. These were the four groups that were specifically invited to join:

- Hotel pioneers: People working in operational departments of hotels, such as reception, housekeeping, food & beverages, who excel in innovative spirit.
- Eco-conscious travellers: People with an eco-friendly mindset, who aim at prioritising the preservation of nature during both business and leisure trips.
- Travel visionaries: People with a unique perspective on traveling, such as senior citizens, people with disabilities, single travellers, and the LGBTQI+ community.
- Outdoor enthusiasts: People, who love outdoor activities, such as backpacking, camping, and hiking.

Table 2: Overview on the finalist projects – second challenge.

Name	Details
Cook & Home	A digital platform that links tourists with local hosts for authentic culinary experiences. It allows tourists to connect with citizens passionate about sharing their local cuisine knowledge while enabling hosts to earn extra income and engage with people globally. The platform prioritizes user-friendliness, particularly inviting senior citizens to serve as hosts.
Smart White Cane	A walking stick for visually impaired individuals navigating unfamiliar environments. It employs IoT, AI, and robotics for real-time obstacle detection, voice guidance, and emergency alerts, ensuring safe and inclusive travel experiences.
SunTabs	Innovative pills that transform into sun-protective lotion when dissolved in water. The set includes the pills and a small mixing container, making preparation quick and easy—simply add water and stir. SunTabs last significantly longer than traditional sunscreens, are lightweight for easy travel (no liquid), and feature sustainable packaging with natural, vegan ingredients.

Three of the vie finalist projects are listed below. More details on them and the other projects can be found on the challenge website[5].

CHALLENGE MANAGEMENT

Based on the first challenge learnings, FRANCIS adapted the design of the challenge process and support to increase efficiency and ease participation. The following table highlights some of the main similarities and differences between both challenges.

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[5] https://s.fhg.de/francis-challenge

Table 3: Overview on the challenge management of the two challenges.

Components	Commonalities	Differences
Process	Three rounds: ideas – concepts – demonstrators	Consecutive rounds in the first challenge; rounds one and two in parallel in the second challenge
Platform	Challenge website for collecting and managing submissions	One multi-lingual website for all participants in the first challenge; three separate websites (one per language) in the second one
Participants	Focus on underrepre-sented groups of society	Active and passive participants in the first challenge (working on vs. providing feedback to solutions); active participants only in the second one
Mentors	Mentors from science and industry	Regional facilitators and students as hands-on support buddies for the teams in the first challenge; regional facilitators only in the second one
Industry	Industry as jury members and coaches	One company as industry coach in the first challenge that is part of the project consortium; several external companies as coaches in the second one
Outreach	Local outreach partners in the target countries	Outreach partners as support for regional facilitators in the first challenge; outreach partners supported by regional facilitators in the second one

The facilitation of the FRANCIS challenges was done by regional teams (one for each language group) that kept in close contact to plan and prepare their activities and to exchange lessons learned. The scientific facilitators used a toolbox with the methods shown in Table 3. Figure 1 illustrates the process. The methods of the toolkit were used in some way in both challenges.

Table 4: Overview on the FRANCIS toolbox.

| Activity	Method(s)
Learn about potential customers	Interviews, personas
Learn about competitive solutions	Benchmarking
Detail a product	Morphological box
Detail a service	Customer activity cycle
Design relevant business model aspects	Business model canvas
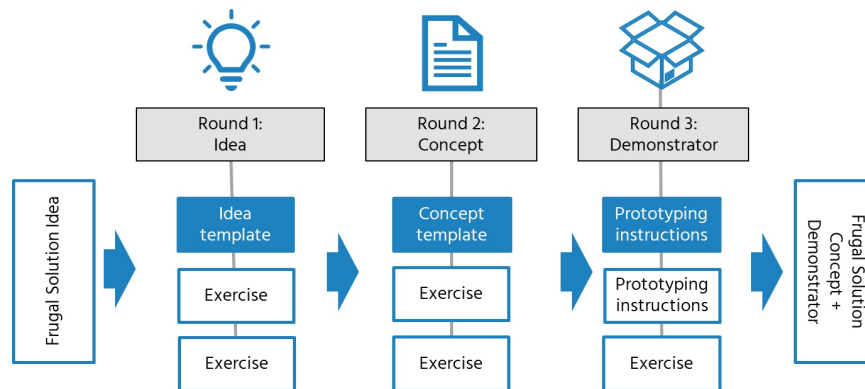
Figure 1: FRANCIS challenge facilitation process.

CHALLENGE STATISTICS

The data that was collected through the challenge platforms includes statistics on the number of participants and submissions as well as the age of the participants and the team sizes. FRANCIS aimed at achieving the following Key Performance Indicators (KPI) in its outreach and support activities:

- A high number of participants and submissions in the first, open round. The aim of both challenges was to end with about five teams in the final round, so FRANCIS selection process ensured a significant reduction of submission in the second round, before focussing on the finalists.
- A diverse group of participants. FRANCIS specifically hoped to encourage the participation of underrepresented groups of society. The participants of the first challenge that were assigned to these groups were "troubled families" and "independent senior citizens". In the second challenge, the categories "hotel pioneers" and "travel visionaries" targeted people that had a unique perspective.

The statistics of both challenges are presented below. The figure below highlights the changes in challenge participants. While the first challenge still showed moderate outreach success with 119 people joining the first round, the second challenge manage to dramatically increase the number to 568. Both numbers include ten participants that joined both rounds. The numbers stress the positive impact of the adjusted outreach strategy.
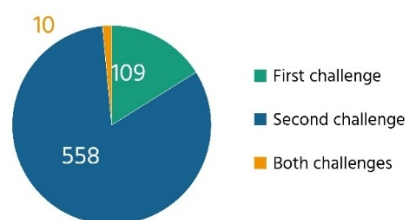
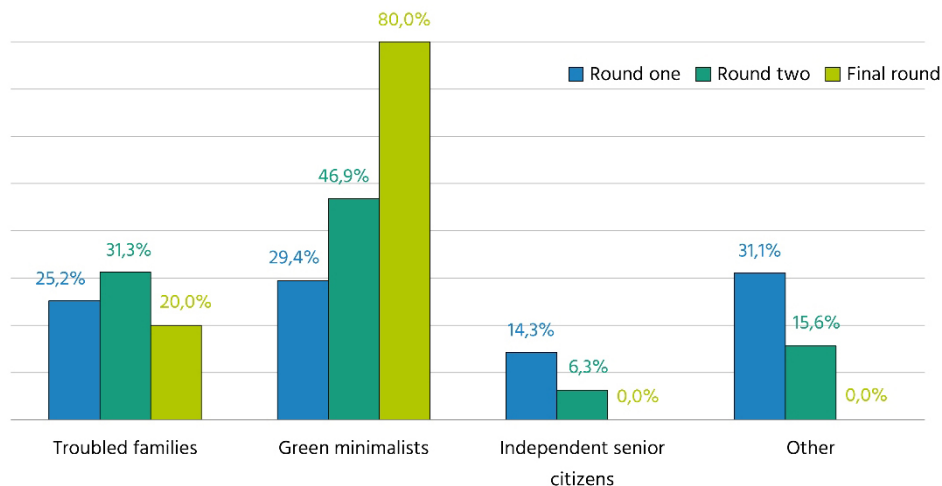**Figure 2**: Number of challenge participants.

When it comes to the number of submissions, there was also a strong increase from the first to the second challenge, as the figure below shows.
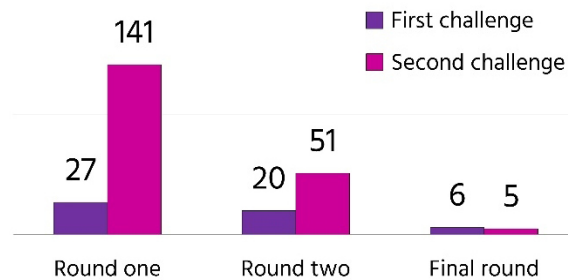
Figure 3: Number of submissions.

Due to the new agile round one/two design, the number of submissions in round two of the second challenge was also much higher than the one in the same round in the first challenge. The last round of both challenges was as small as planned.

The figure below shows the participant groups of the first challenge. The number of troubled family members and independent senior citizens was between 37.6% and 39.5% for both groups combined in the first two rounds. The last round included two people from troubled families (20%).
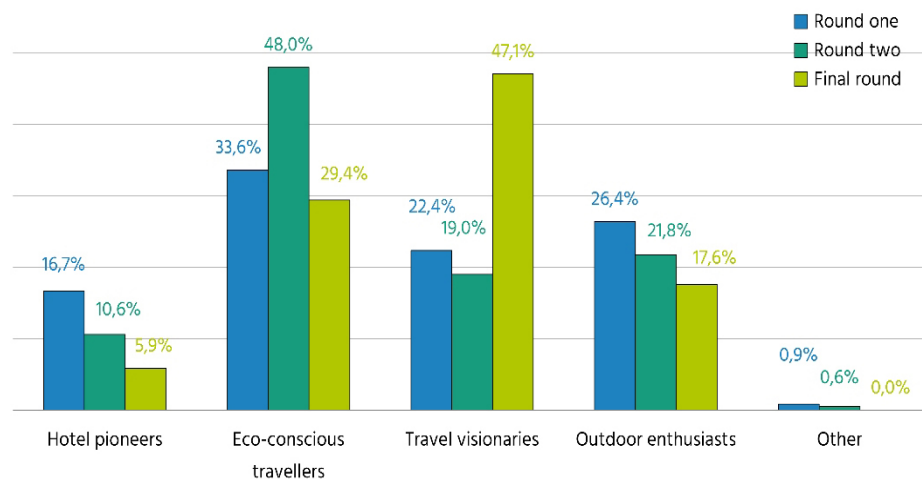

Figure 4: Participant groups – first challenge.

The numbers of the second challenge again show that the adjustments made to the challenge design entailed improved KPI.

Hotel pioneers and travel visionaries combined achieved between 29.6% and 29.1% in the first rounds. The number of participants from these groups, who made it to the last round, were 53.0% of all finalists. The result also showed in the types of projects that made it to the end, with most of them

specifically addressing issues of importance for underrepresented groups, such as people with disabilities, elderly people, and women.

Figure 5: Participant groups – second challenge.

IMPACT MEASUREMENT

FRANCIS aims at capturing the potential impact of the challenges based on the United Nation's Sustainable Development Goals (SDG) and relevant aspects of Responsible Research and Innovation (RRI). The project started with an indicator library that includes at least two indicators for every SDG goal and every RRI key. While the SDG were applied for capturing the impact of the challenge results (i.e. the frugal innovations), the RRI served for assessing the impact of the challenge process (i.e. the project's support for the three rounds).

The indicators were largely formulated as self-reflective questions and directed at multiple stakeholders with a role in the innovation challenge: the challenge participants, the regional teams and the jury members. In the first challenge, the questions were included in the challenge platform; participants had to answer them when completing their submissions. The second challenge presented them in a separate survey. In addition, it ran participant interviews and invited the consortium to reflect on the impact of the finalist projects in an online workshop.

The framework changes result from several lessons in the project. Having fewer repetitive surveys, enhanced by interviews, decreased the submission barriers and ensured richer data from the participants, also because the separate survey made it more explicit that these questions did not impact the advancement of the team.

The additional consortium workshop was able to cover all seventeen SDGs and to provide various information about the expected impacts of the projects. Content-wise, FRANCIS evaluation showed that all finalist projects had substantial impact potential with respect to relevant SDG such

as "good health and well-being" (SDG 3), "reduced inequalities" (SDG 10) and "responsible consumption and production" (SDG 12). However, to materialise these potential impacts in all cases requires continuous efforts from and support for the participants.

LESSONS LEARNED

FRANCIS gathered insights on many different aspects of Citizen Frugal Innovation during the challenges. The complexity of the challenge management resulted from the fact that they did not only address various countries and target groups. They also involved different types of stakeholders with specific roles. The following table highlights some of the key aspects.

Table 5: Lessons learned on challenge management.

Components	Lessons Learned
Process	The process with two parallel rounds increased the time for outreach activities and ensured that participants were able to move on fast
Platform	Having several platforms, one for each language, made it easier to streamline communication. It, however, resulted in the need to foster stronger collaboration between regional teams and data integration issue
Participants	Instead of supporters, interviews with potential customers made more sense for feedback
Mentors	The study buddy concept did not work as planned, a focused support team proved to be more suitable
Industry	One dedicated coached seemed more useful
Outreach	It was good to give the outreach partners more power, and to even include them as facilitators

Lessons learned from FRANCIS impact evaluation for future research includes four main points:

- Evaluation questions should be kept very simple, short, and restricted in number (max 10 per survey), especially for non-expert stakeholders.
- Evaluation questionnaires, especially impact related questions, should not be included in submission templates but in a separate survey.
- Expert stakeholders such as challenge coordinators can contribute to a more extensive evaluation that includes all seventeen SDG. For non-expert stakeholders, qualitative descriptions of expected impact that are later matched against SDG are a better approach.
- In general, an indicator library such as the one provided by FRANCIS is helpful to design suitable evaluation instruments, but the indicators must be tailored to the specific purpose, target group and challenge design.

CONCLUSION AND OUTLOOK

FRANCIS has been an exciting project with many insights that are relevant for future research. The project consortium hopes that these insights will be

leveraged in upcoming projects and is happy to support related initiatives. The consortium is currently consolidating the project results and will publish them in various media, most of all a podcast series, a manual for various stakeholder groups (industry, research, civil society organizations) and a series of webinars.

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