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Evolving the "How Might We?" Tool to Include Planetary Boundaries

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Abstract

This work aims to study the evolution of the "Human and planet balance tool" as part of Prosperity Thinking. Prosperity Thinking is a sustainable design methodology that takes into account human and planet means. Through a literature review on sustainable design, we noticed that there is a lack of methods that take into account the problem definition stage. We developed a "Human and planet balance tool" which helps framing sustainable design challenges. Results show that designers, innovators, and changemakers have an interest in a methodology to analyze and address systemic challenges.

Keywords: sustainability, design tools, complex systems, design process

1. Introduction and Motivation

As society is becoming more aware of the issues related to their impact on the planet (Elhacham et al., 2020), humans are trying to be more sustainable in their lives starting from design and production. This is why Prosperity Thinking was born. (Vignoli et al., 2021). It is an evolution of the design thinking methodology that aims at implementing sustainable design processes that take into account our planet's means together with humans' needs from the very first steps. We are developing Prosperity Thinking starting from the Food sector because food is the first-ever product of humanity, that has important impacts both on our lives and on the planet. Moreover, it is responsible for one-quarter of the world's greenhouse gas emissions (Clune et al., 2017). Prosperity Thinking has a systemic approach, it is based on the Triple Bottom Line idea of sustainability and it takes from Kate Raworth's Doughnut model. It is composed of three main phases: "Problem Framing", "Ideate and Prototype" and "Test and Analyze". Their scope is to address a design challenge which is able to properly include the planet's needs. In this paper, we want to explore and understand the evolution of one of the tools to be included in the Prosperity Thinking method, which is the "Human and Planet balance tool", and its future trajectories.

In order to have a clear understanding of the present methodologies we performed a literature review on design for sustainability methods, which is by today very rich. We clustered the Sustainable Design tools in the Problem Framing phase in chapter 2, identifying Problem Definition as an area that is not well covered in previous literature. Chapter 3 presents the methodology we used, while in chapter 4 and 5 we report the evolution of the "Human and Planet balance tool" based on empirical studies. In the final chapter we discuss our results, limitations and propose future research directions.

2. Theoretical Background

As the literature stream of sustainable design is quite active, in order to verify a correspondence between Prosperity Thinking phases with other sustainable design methodologies, and to collect the most common tools used in each of the phases, we performed a systematic literature review. To do so, we performed a Scopus search using the following query: TITLE-ABS-KEY ("design for sustainability") AND TITLE-ABS-KEY (model OR process OR framework OR approach OR method) AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "re")). This resulted in a list of 209 articles of which only 43 were selected after reading the title and abstract. They are reported in Figure 1 divided by year of publication, while Table 1 represents the major sources of publications.
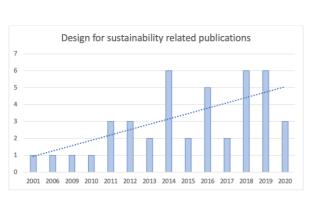
Table 1. Top sources

Figure 1. Publications by year

Source	N°of articles	N°of citations
Journal of Cleaner Production	6	118
Sustainability (Switzerland)	5	46
SpringerBriefs in Applied Sciences and Technology	2	2
Journal of Engineering Manufacture	2	25
Design Studies	2	288
Artificial Intelligence for Engineering Design, Analysis and Manufacturing	2	2
Renewable and Sustainable Energy Reviews	1	245
Automation in Construction	1	140
Implementation Science	1	122

These articles were read in detail starting from the most recent to the oldest one, and twelve of them going from 2003 to 2019 were considered more in depth as they reported specific tools and process phases. They are reported in Table 2 where their phases are shown in comparison to the Prosperity Thinking ones.

All the approaches described in this paragraph seem to have some common characteristics with at least one of the phases structuring Prosperity Thinking (Vignoli et al., 2021). This is indeed a validation of the structure of Prosperity Thinking, as all other sustainable design processes considered could be reported to the three phases.

We then analyzed the tools that each methodology was proposing for each phase. Following is a comprehensive list of tools divided by phase.

Problem Framing: Customer/User observation and interaction; Kano technique; Market desire/need template; concepts template; extended enterprise template; SWOT Analysis; Benchmarking, Ecodesign PILOT; Eco-indicator 99; Environmental Effect Analysis; Preliminary Hazard Analysis; Quality and Environmental Function deployment; Morphological Matrix; Intervention Chart; Environmental Effect Analysis; Preliminary Hazard Analysis; Mapping the state of art GIGA-MAP; Establish boundaries, create categories; Desk Research and Field research; Databases and Synchronized dialogues;

Ideate & Prototype: Brainstorming; Rough prototyping; Concept development, Engineering, Prototyping and Testing (Life Cycle Assessments (LCA), Ecological Rucksack (or Material Input per Service Unit (MIPS)), Total Material Flow (TMF), Ecological Management; LCA; Defining the user scenario; D4S Impact Matrix; D4S strategy wheel, D4S design brief, D4S strategies, D4S Impact Assessment and D4S drivers, brainstorming; Green quality function; HAVTEC Technique; Environmental Effect Analysis; drawing, sketching, solution maps, future scenarios, storyboards;

Test & Analyse: Checklist for environmental and social impact; Sourcing, Tooling and Scaling-up; test models, prototypes, and computer simulations,

General: PD (product development) questions; sustainability product assessment (SPA) and prioritisation matrix

All the tools mentioned above come from sustainability design related methodologies; many of them have a strong technical trait and are often data driven: LCA, D4S impact matrix or ProdSi index are some examples. Their value is to highlight some sustainability indexes and measurements (like CO_2 emissions

during the product lifecycle or use of water from production to end-of-life), which are surely fundamental to be included in a methodology such as Prosperity Thinking and will be in future developments. However, the focus of this paper is on tools which allow reflecting and interpreting sustainability challenges since they are often complex and 'wicked' for which a starting explorative phase is essential. For this reason, we focused on tools belonging to the first phase and we clustered them according to their scope, trying to understand if they are used for research, analysis, mapping, framing or problem definition purposes.

Table 2. Analysis of the phases of sustainable design methodologies

	Problem Framing	Ideate & Prototype	Test & Analyse
SPSD (Maxwell and van der Vorst, 2003)	Concept stage	Identify the life-cycle stages and associated supply chain	Asses environmental and social impact
Road-map (Waage, 2007)	Understand	Explore; Define and Redefine	Implement
MSPD (Byggeth et al., 2007)	Investigation of need	Principal product phase; primary product phase; production process phase	Launching phase
FSSD (Byggeth et al., 2007)	Members study the methodology; Assessment of the current situation	Brainstorming for solutions; prioritisation of actions	
TSPDs (Ny et al., 2008)	Discuss the framework	Brainstorming; identify alternative solutions; evaluate and prioritize	
D4S (Crul and Diehl, 2009)	Goals and strategies	Idea finding; Strict development	Realisation
Double Flow scenario (Gaziulusoy et al., 2013)			Preparation; Scenario development; Completion
DMS (Fargnoli et al., 2014)	Planning; Concept development	System-level design; Detail design;	Testing and Refinement; Production ramp-up
MDM (Joore and Brezet, 2015)	Reflection	Analysis; Synthesis	Experience
SD (Battistoni et al., 2019)	Holistic Design; Definition of problems	Design of a system; Study of the outcomes	Implementation; Analysis of the results
HD (Battistoni et al., 2019)	Assess; Research; Collect; Visualize; Interpret		
DfSS (Corsini and Moultrie, 2019)		Product; Process; Paradigm	

As it is possible to see in Table 3, we could not find tools for Problem Definition scopes. As mentioned before, this is an essential moment of a design process aiming at implementing innovative sustainability-related innovations: "Adequate and comprehensive problem definition is a key step in any type of innovation process, but it is particularly true when innovating for sustainability" (Wilkerson and Trellevik, 2021). Out of all the different ways of performing Problem Definition, the "How might we" tool was chosen as a starting point for our development since that it is a consolidate tool of Design Thinking methodology from which Prosperity Thinking is evolving, and because it is also used in the System Thinking approach (Siemon, et al., 2018). Moreover, it is a widely diffused design instrument and the authors are very familiar with it having already used it in many projects. The next paragraphs will show how this tool was adapted and evolved to better suit sustainability challenges specific needs.

Table 3. Sustainable design tools in problem framing phase

Scope	Tools
Research	Customer/User observation and interaction (Maxwell and van der Vorst, 2003); Benchmarking (Fargnoli et al., 2014); Desk Research and Field research (Battistoni et al., 2019); Databases and Synchronized dialogues (Battistoni et al., 2019)
Analysis	SWOT Analysis (Crul and Diehl, 2009); Preliminary Hazard Analysis (Fargnoli et al., 2014); Environmental Effect Analysis (Fargnoli et al., 2014); Eco-indicator 99 (Fargnoli et al., 2014); Ecodesign PILOT (Fargnoli et al., 2014)
Mapping	Quality and Environmental Function deployment (Fargnoli et al., 2014); Mapping the state of art GIGA-MAP (Fargnoli et al., 2014); Market desire/need template (Ny et al., 2008); Concepts template (Ny et al., 2008); Extended enterprise template (Ny et al., 2008)
Framing	Kano technique (Waage, 2007); Morphological Matrix (Fargnoli et al., 2014); Intervention Chart (Fargnoli et al., 2014); Establish boundaries (Battistoni et al., 2019) ; Create categories (Battistoni et al., 2019)
Problem Definition	-

3. Methodology

This study aims to test in practice the design of the "Human and Planet balance tool", derived from a classical "How might we?" (Siemon, et al., 2018) created to incorporate planetary boundaries and social foundation (Raworth, 2017) in a design challenge. We used an Action Research Innovation Management Framework (Guertler et al., 2020). We followed the five circular phases provided in the AIM-R framework. We started with an (1) analysis and framing of the evolution of design for sustainability methodologies, to identify and cluster all their different phases and check the coherence with the steps we have in Prosperity thinking. Different authors highlight the fact that there isn't yet a clear and easy framework designers can follow while seeking for sustainable solutions, plus they agree on some factors that these methodologies should have: including sustainability from the start, having a systemic vision and thinking in long terms. For these reasons, and thanks to the analysis of all the steps these frameworks suggest we could make a positive comparison with Prosperity Thinking methodology because it respects all the values listed before and incorporates all the different phases identified in its own ones. Analyzing them as described in §2, we perform (2) project planning by identifying a relevant field to initiate our action. Out of all possible fields, we identified the food sector as the best candidate to start prototyping our revised "How might we?" instrument since this sector intimately has significant implications for our planet. Next, we focused on (3) execution of the action with four iterations of the initial "How might we?" statement (the name evolved through the iterations) in the context of FAO and Future Food Institute boot camps. We tested the "How might we?" statement in one hackathon, two workshops and a prototype testing with six experts. During the execution, the authors were involved as conductor and participant observers. The authors analyzed all the material during the (4) reflection and learning phase. With this preliminary work, we are conducting the (5) communication and pivoting phase. We collected 40 hours of observation, field notes, a survey for each workshop and hackathon participants and prototype feedback from colleagues. All the meetings to develop Prosperity Thinking, as discussions

and reflections on the prototypes, were documented with minutes and archived. During these bootcamps a total number of 154 participants coming from 61 countries were involved. Their backgrounds can be summarized in the following categories: students; researchers and academics; entrepreneurs; agriculturists; culinary experts; activists and designers.

From July 2020 to September 2021, we conducted 4 iterations and one pre-iteration of our "Human and planet balance tool" as presented in Table 4.

Table 4. History of the iterations

Iteration	Name of the tool	Status of the tool	Context of application
Pre-iteration - July 2020	-	Theoretical presentation of idea of problem definition + importance of taking the planet in consideration	Pollica in presence Boot Camp 2020 (13 participants.) Participant backgrounds - Global public health, User experience & user research, International affairs / economics, Sociology, Food systems
Iteration 1 - July 2020	How might we problem statement (from IDEO)	How might we enable <Actor> that <need> to <goal>?	Digital Boot Camp #1 (26) Participant backgrounds - Culinary/ Food science/Nutrition/ Food tech, development studies, Arts/Humanities, Environmental economics & policy, Global public health, User experience & user research, Psychology, HR management, Sociology, Hospitality/ Tourism, International affairs / economics, International business, Industrial engineering
Iteration 2 - March/May 2021	Trade-off based challenge statement	How might we enable <Actor> to <need/goal> while <planetary need / boundary / pain>?	Digital Boot Camp #2 & #3 (79) Participant backgrounds - Computer science, Biomedical engineering, Food tech, Applied management, Commerce, International studies/relations/agriculture, Food studies, Oceanography, Environmental policy/engineering, Ecology & evolution, Business administration, Trade marketing, Psychology, Economy, Health & Food risk, Rural development, Urban planning, Development studies, Marketing, Natural Resource management, Biology, Journalism, Strategic design, Hospitality/ Tourism, Innovation, Engineering, Product & consumer management
Iteration 3 - June 2021	Human and Planet balance statement	How might we enable <Actor> to <Planetary boundary/social foundation> while <their need/goal>? + How might We Table	Prototype testing with colleagues and Digital Boot Camp #4 (26) Participant backgrounds - Food science & tech, Agriculture food & environment, Arts & Culture, Food design /Innovation, Computer applications, Culinary sciences, Marketing, Public health & management, Human kinetics, Economics, Strategy, Resource management, Applied IT, Communication, Applied mathematics, Agriculture, International business

Iteration 4 - September 2021	Human and Planet balance statement	How might we enable <Actor> to <Planetary boundary/social foundation> while <their need/goal>? + How might We Table + HMW self Validation	Pollica in presence Boot Camp 2021 (10) Participant backgrounds - Interior/product design, advertising/ marketing, Food systems, Business management, Political/social sciences, Arts/Vis com, Food science/tech, Environmental sustainability, Development studies

4. The Human and Planet balance tool

The "Human and Planet balance tool" is a tool from the Prosperity Thinking methodology that helps the designer to define a clear design challenge which takes into account the planetary means from its very beginning. In a Prosperity Thinking workshop, before using this tool, a designer needs to understand who the stakeholders are and their needs, the planetary boundaries and the objective of his/her project. Participants are in fact asked to 1) choose a planetary challenge they want to tackle by researching an 'unsustainable event or phenomenon' like ocean acidification, landfills, etc. 2) reflect and deconstruct the planetary challenge through the use of the Iceberg model (which analyzes the unsustainable event deep diving in understanding the patterns, structures and mental models) and 3) Fill the "How might we table" in order to piece together all the actors, their actions, needs, planetary boundaries and social foundations, 4) Write a "Human and Planet balance statement" which coincides the human need and the planetary boundary.

The "Human and Planet balance table" (Figure 1) is a tool which helps the designer to put on the same page all the stakeholders included in an unsustainable event (on the left): these actors can be both those who actively concur to it but also actors that apparently are subjected to these. On the other side of the spectrum there are the planetary boundaries/social foundations (impacted). In the middle of the table, we analyze the actions produced by the actors and their needs/goals that drive these actions. This step helps us connect the actions, drivers, mental models, and planetary boundaries to each specific stakeholder, making it clearer to identify one specific stakeholder to frame the 'Human and planet balance statement' in the following step.
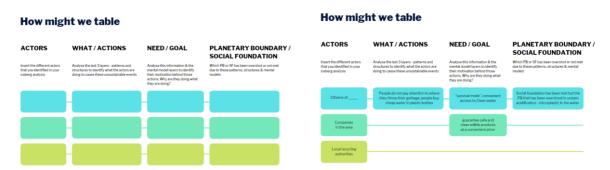

Figure 2. Human and planet balance table

After filling the "Human and Planet balance table", workshop participants are invited to create a "Human and Planet Balance statement" (Figure 3). As we will see from this paper this statement is an evolution of a "How might we?" statement, used in design to reframe a challenge and create new ways to approach it. In the "Human and Planet Balance Statement" we have inserted Planetary boundaries and social foundations (Raworth, 2017) which need to be considered in the creation of a design challenge, while also satisfying human needs.

Figure 3. Human and planet balance statement

The final part of this step helps the students to check if they produced an operational "Human and Planet Balance statement". To be operational it should contain a specific actor (one of those identified in the "How might we table", a specific geographical location and a precise action verb (e.g. "have a positive impact" is not a precise action verb, "reduce the quantity of used water" is a precise action verb).

Figure 4. Human and planet balance gut check

5. Results

5.1. Pre-iteration and iteration 1: introducing the idea planet in design challenges and testing a classical "How might we?"

We first started with a pre-iteration in July 2020 in the context of the Pollica Bootcamp organized by the Future Food Institute, a center of excellence for food intelligence and a training platform for changemakers, climate shapers, and future leaders in the food innovation ecosystem. Here we presented for the first time a theoretical presentation of the idea of problem definition and importance of taking the planet in consideration, without developing the "Human and Planet balance tool" yet. This phase helped us put the basis of our work. During the final part of the 1st Digital Bootcamp we introduced a "How might we?" tool (Siemon et al., 2018), that we tested trying to insert an environmental problem in the Design challenge.

Example 1st Iteration: *How might we help chefs and producers (farmers) that want be more sustainable to reduce food waste and food loss whilst reducing food costs and earning a profit to connect with each other?*

During this phase it wasn't clear how to include the planet in the process of creating a design challenge. In this first iteration, resulting statements were very generic and the needs/goals remained broad and not situated in a concrete context. In fact, general expressions like "to be more sustainable" were present in the workshop participants' statements without specifying a specific action (e.g., reducing the use of water, reducing the use of energy...).

5.2. Iteration 2: the addition of planetary need/boundary/pain

Since we were not satisfied with the result of the "How might we?" tool, during March and May 2021, we tested a new version of the tool that we called "Trade-off based challenge statement". This new version clearly included the "planetary need/ boundary/pain":

How might we enable <Actor> to <need/goal> while <planetary need / boundary / pain>?

The Trade-off based challenge statement was tested for the first time during the 2nd Digital Bootcamp of Future Food Institute in March 2021. We decided to change the "How might we?" tool to clearly introduce and make explicit the idea that the planet must be included in the creation of a Design challenge. During this phase new statements were produced by the students:

Example 2nd iteration: *How might we enable local logging companies in Amazon to turn down destructive work and have a positive impact in the community while economically sustaining themselves and families?*

In this phase students were positively inspired to act, but issues in the creation of the Trade-off based challenge statements persisted. Placing the human need before the planet led to the same thinking pattern where humans come before nature, confusing the participants interested in sustainability and generating profit-driven statements as opposed to sustainability-driven. Moreover, we understood that asking practitioners to include the planet in the creation of their Design Challenges wasn't sufficient in clearly defining the actors and scope of intervention. That process needed to be accompanied and explored more in detail.

5.3. Iteration 3: Human and Planet balance table and statement

Thanks to iteration 1 and iteration 2, to support sensemaking of the complex interactions between people and planet in the problem framing phase, we decided to create a "*How might we table*". This is a table in which practitioners could analyse the challenge differentiating by the type of actor involved, the actions she is involved in, the need/goals and finally the planetary boundaries/social foundations that are affected by his actions. Thanks to this table, practitioners were able to understand the variety of actors involved in a challenge and evaluate which actor to focus on for the ideation.

How might we table

ACTORS	WHAT / ACTIONS	NEED / GOAL	PLANETARY BOUNDARY / social foundation
Farmers	Sometimes in a difficult financial situation & persuaded by neighboring farmers & chemical companies + incentivized to monocrop and/or grow as much as possible as fast as possible	To maintain their livelihood, serve the community & keep up with relevant tech/innovations in their industry when necessary & holistically beneficial	Long term damage to soil & water. Disease & death to consumers, neighbors, the public (massive rise in cancer rates, autoimmune diseases, infertility)
Agro-chemical companies	A vicious short-term, profit-only mindset showing no concern for human or environmental health. Apathy & disconnect from the symbiotic reality of & our place within a diverse natural ecosystem	To make money, grow & answer primarily to shareholders	Long term damage to soil & water. Disease & death to consumers, neighbors, the public (massive rise in cancer rates, autoimmune diseases, infertility)
Food companies	Short-term, profit-only mindset. Lack of depth & real accountability in supply chain	To make money, grow & answer primarily to shareholders (and hopefully responsibly feed the community)	Long term damage to soil & water. Disease & death to consumers, neighbors, the public (massive rise in cancer rates, autoimmune diseases, infertility)
Government	Misallocation of subsidies, being too influenced by lobbyists & corps who profit from the system as is	To stay in office & supposedly do what's right for the common good (though this is not always the case)	Long term damage to soil & water. Disease & death to consumers, neighbors, the public (massive rise in cancer rates, autoimmune diseases, infertility)

Figure 5. An example of How might we table filled by a workshop partecipant

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In Iteration n.3 we also brought two main changes in the "Trade-off based challenge statement" that we changed into "Human and Planet balance statement". First, we widened the concept of planetary boundary, with the concept of "social foundation" that we define as the human basic needs and rights that need to be fulfilled while thinking about a planetary challenge and that cannot be left apart (Raworth, 2017). The second main change was to invert the position of "planetary boundaries/social foundation" in the sentence. These were in fact placed in the second position, instead that at the end of the sentence:

How might we enable <Actor> to <need/goal> while <**planetary need / boundary / pain**>?

How might we enable <Actor> to <**Planetary boundary/social foundation**> while <their need/goal>?

This change was made to reinforce the idea that both planetary boundaries and social foundations need to be considered at the very beginning of the project phase and not as an appendix of it. The "Human and Planet balance statement" and the "How might we table" were tested in a focus group with six experts at Future Food Institute. The results of this test and the feedback received from the experts helped us understand that the table clearly helps to differentiate and have on the same page all the driving forces (need/goal) of each of the actors involved in a complex environmental challenge. Statements with a precise vision and lexicon were in fact achieved:

"How might we enable municipalities to fight water scarcity while keeping refurbishment of water infrastructures convenient?"

The main difficulties acknowledged from the test of this interation were:

- Some participants didn't feel confident since they hadn't enough data/information concerning the challenge they were tackling: *"A lot of the patterns, needs, etc were assumed by me based on my idea of human behavior since I did not find any direct mention of those topics"* - V.
- Since there are many stakeholders involved it was suggested to produce not a unique *"Human and planet balance statement"* but a statement for each of the actors involved

5.4. Iteration 4: "Human and Planet balance tool"

Iteration number 4 was conducted in Pollica, Cilento (Italy) during a Bootcamp in September 2021. Pollica is a town in South Italy, that is considered to be the hometown of the Mediterranean Diet and in which Future Food Institute hosts its Bootcamps (one-week international training programmes on sustainability in the food sector). Here participants, using the tool after research sessions with local stakeholders, produced challenges that were anchored to the local territory and that were considered applicable design challenges.

Example 1: *How might we enable small producers like Silvia to spread local, high-quality and nutritious food in Cilento while being accessible (affordable, available and acceptable)*

Example 2: *How might we enable fishermen like Vittorio to preserve the diversity of the Mediterranean sea as an ecosystem while earning a living?*

6. Discussion and Conclusion

The "Human and planet balance statement", together with the "Human and planet balance table", appear to be a useful tool in the construction of a Sustainable Design challenge. With the four iterations exposed in this article we had the opportunity to understand the power and the current limitations of the "Human and Planet balance tool". Students and professionals that participated in our activities reported that this tool was useful and that they would use it in their professional activities.

The "How might we?" is a traditional tool that was born in the field of product design in order to stimulate designers to tackle challenges in a different and more creative way (Siemon et al., 2018). In this field the different components of the challenge are more or less under our control and we have a clear understanding of them: time, costs, resources, materials and so on. When we apply this tool to environmental challenges we don't know every factor and not every factor is under our control. The "Human and Planet balance tool" can therefore become a tool on which aspects of environmental challenges can effectively have an impact and it can therefore help us define our limits of action.

In order to do this, we imagine a collaboration among disciplines with the aim of understanding which intervention activities we effectively have at our disposal to tackle an environmental problem, which is

the space of action that someone has at a certain level. This tool could therefore evolve from a "How might we…" formulation to a "What conditions should occur for...?".

The reflection on the tool should also take in consideration the nature of the problem, asking ourselves questions like "What is the problem here?". The development of Prosperity Thinking should help understand for example if the nature of the problem is legal, political or industrial, or the three at the same time. Prosperity Thinking wants to avoid what sociologist Evgeny Morozov (2014) calls "solutionism", when things become problems because we have tools to solve them, rather than because we have decided they are things that need to be solved. Professor Melanie Smallman, Associate Professor in Science and Technology Studies and Co-Director of UCL's Responsible Research and Innovation Hub, in the SISCODE Project proposes a series of questions that policy designers should ask themselves in order to design a good project or a good policy: What is the problem that needs to be solved? Whose problem is this? Who should be solving the problem (is it us? Are we the right people?) How can this problem be solved? How are the voices of end-users being heard in the process? Our future research will take into account these questions.

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