

The challenges of and solutions for combining cocreation and agile in the development of health information technologies

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ABSTRACT

Background: Involving users has become a prominent principle in the development of Health Information Technologies (HIT) and has led to an uprise in agile and cocreation methods. Previous literature shows how the two can be combined in one method, but also suggest that using such a method may come with challenges, for which the solutions are unclear.

Purpose: To identify the challenges of using a method that combines agile and cocreation, provide solutions for these challenges, and evaluate its usage.

Methods and materials: The setting for this research was the Agile Cocreation of Robots for Aging (ACCRA) project. The research consisted of three phases: 1) evaluating the Agile Cocreation method to identify challenges in its usage, by analysing documents from the project (e-mails, meeting notes), 2) solving the challenges to improve the method, by designing solutions in a cocreation session; and 3) evaluating the usage of the improved version via a survey among engineers and user researchers involved in the project.

Results: We identified three main challenges and developed three solutions, which were used in the next phase of the project. First, to engage all stakeholders in cocreation, we implemented more fun and playful materials. Second, to bridge the differences between engineers and user researchers we invested in face-to-face meetings. Third, to manage knowledge in the project we intensified our meeting schedule to weekly meetings. In the quantitative evaluation of the improved cocreation method, the engineers and user researchers were positive about the agile cocreation method and about our improvements.

Conclusion: When developing HIT, a method that combines agile and cocreation is useful because it helps to identify user needs and to translate these needs into technology. To identify the needs of these users and other stakeholders it is important to involve them as active partners in cocreation using fun and playful materials. Engineers and user researchers should bridge their differences and meet face-to-face as much as possible.

1. Introduction

Involving users has become a prominent principle in the development of Health Information Technologies (HIT) [1–9]. Some even state that user involvement in the development of products, services or systems has become the dominant paradigm for technological innovations

and has led to an uprise in agile and cocreation methods. Agile methods are replacing traditional (step-by-step) waterfall models as it is presumed that they are more responsive to the perspective of the customer through its use of short iteration cycles based on user stories and user feedback [1,4,8–10]. Cocreation approaches, such as co-design, participatory design, and generative design, are deemed to avoid

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suboptimal products and services by actively involving users [2,3,8,11].

Although both agile and cocreation approaches aim to involve users in development, they are different in terms of their purpose of involving users and how this is achieved. The purpose of cocreation is to explore the needs for a product or service by enabling users to express these needs. It uses tools and techniques such as cultural probes, generative sessions, and prototypes [12]. User researchers are generally in charge of involving the users and are in frequent interaction with them. The purpose of agile, on the other hand, is to translate user needs into fitting products, whereby the tools and techniques of agile (e.g. stand-ups, user stories, backlogs) facilitate quick and prompt collaboration between engineers and the representative of the user [13]. Exactly because of these differences, agile and cocreation are both valuable in innovation projects. Previous literature (see Table 1) shows how the two can be combined and describes that using such a method results in the quick and iterative development of HIT technologies that users want and need. Despite this promise, prior studies also suggest that using a method that combines agile and cocreation may come with challenges [14–18]. However, these studies did not explicitly focus on uncovering such challenges nor their solutions. Therefore, in this research, we aim to identify the challenges of using a method that combines agile and cocreation *and* we provide solutions for these challenges. We improve the method taking the solutions into consideration and evaluate its usage.

2. Materials and methods

2.1. Research setting

The setting for this research was the Agile Cocreation of Robots for Aging (ACCRA) project, an international project in France, Italy, The Netherlands and Japan. The goal of ACCRA was to develop various applications (mobility, daily life and conversation) for two socially assistive robots (SARs), ASTRO and Buddy, to extend active and healthy ageing of older adults in long term care facilities [19,20]. A total of 207 users (87 older adults, 64 formal caregivers, 25 informal caregivers, and 31 others such as managers, volunteers and students) participated in the study. 11 user researchers (backgrounds in health services research, design, marketing) were in charge of actively involving these users in the development and 18 engineers (backgrounds in IT or robotics engineering) translated the gained user insights into applications for the SARs. The developmental phase lasted 18 months (October 2017 – March 2019).

2.2. Agile cocreation method

The Agile Cocreation Method (ACM) was created at the beginning of the ACCRA project, based on previous experiences of engineers and user researchers, and consisted of the *steps* to be followed and the *activities* within these steps, the *stakeholders* that should be involved in each of these activities, and the *tools* should that be used by the involved stakeholders. The first version of the method consisted of 5 steps (step 1 – cocreation, step 2 – analysis, step 3 – creation of stories, step 4 – validation and prioritization of stories, step 5 – creation and prioritization of backlog, defining milestones and development). User researchers were tasked with cocreation and analysis (the latter with the use of a data analysis template), after which (together with engineers) they should create, validate, and prioritize stories (using the project management software). Engineers should continue with the creation of a backlog, milestones and with development. This version of the method was used in two iterations of the development of the SARs (October'17 to September '18). Thereafter the method was evaluated, improved, used in a third iteration (October'18 – April'19) and re-evaluated.

2.3. Data collection and analysis

First, the ACM was evaluated to identify challenges in its use. After

Table 1

Prior literature on the combination of agile and cocreation.

Authors	Focus of the study	Mentioned challenge	Mentioned solution
Rittenbruch et al. 2002	Presentation of a method that combines agile and cocreation and illustrating its usage [14]	Collecting user insights Making sense of large amount of user insights Integrating engineers' ideas into the technology	Digital feedback forms were introduced so users could easily share their insights; a new role was created for collecting user insights A new role was created for making sense of the large amount of user insights A new role was created that focuses on integrating engineers' ideas
Kautz 2010; 2011	Exploration of user involvement (amongst others cocreation) in agile development	Dealing with continuous change in the project Dealing with the lack of user involvement Dealing with customer's doubt in the engineers	Frequent communication and interaction between customers and engineers was introduced Instead of users, customers were involved, and they interacted with engineers Frequent communication and interaction between customers and engineers was introduced
Ferrario et al. (2014)	Presentation of a method that combines agile and cocreation and illustrating its usage	Managing project constraints Managing evolution of the technology Engaging stakeholders and capturing their requirements	Not elaborated on Not elaborated on Not elaborated on
Tang et al. (2018)	Exploration of user involvement (amongst others cocreation) in agile development	Capturing the varied perspectives of the user group	Organizing design meetings
Tessarolo et al. 2022	Evaluating a method that combines agile and cocreation [18]	Dealing with project constraints Dealing with continuous change in the project Managing users during cocreation Solving problems with the technology during demonstrations Eliciting user requirements Dealing with the complexity of prioritizing user requirements	Not elaborated on Not elaborated on Not elaborated on Not elaborated on Not elaborated on

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Table 1 (continued)

Authors	Focus of the study	Mentioned challenge	Mentioned solution
		Translating user requirements into technology	Not elaborated on
		Coordinating with engineers and communicating between engineers and customers	Not elaborated on

each cocreation session in the period of October'17 to September'18 (total of 7 sessions), we noted down the problems that we experienced during development. Moreover, we reviewed all emails and meeting notes of the project participants between October'17 to September'18 on who was involved in the different steps and their experienced barriers and facilitators. This analysis of the challenges was input for the second phase, which encompassed the design of an improved version. We identified the most prominent challenges in a co-design session, at which 11 team members were present (5 user researchers and 6 engineers). Then, solutions were sought in groups, decided upon by all, and integrated into an improved version during a physical meeting of the project team. The improved version was used from September 2018 to March 2019. Lastly, to evaluate the improved version, a survey (see Appendix 1) was deployed. The survey consisted of self-constructed closed and open-ended questions that measured the use (%), and usefulness of the solutions (1 not useful – 5 very useful), the extent to which challenges were solved (%), and the urgency to still solve the challenges (1 not urgent – 5 very urgent), and the involvement (%) and remaining difficulties (1 very easy – 5 very difficult) in effectuating the steps of the ACM. The data was analysed using descriptive statistics, and a narrative analysis of the open-ended questions. The survey was sent to the engineers and user researchers and completed by 20 out of 29 of them, of which 9 user researchers and 11 engineers (see Table 2 for respondent characteristics).

Table 2
Respondent characteristics.

Characteristic	Categories	Number
Role	User researcher	9
	Engineer	11
Educational background	IT development	7
	Robotics engineering	5
	Marketing	2
	Industrial design	1
	Health sciences	4
Highest level of education	Master degree	7
	Doctorate degree	13
Country	France	6
	Italy	8
	Japan	3
	Netherlands	3
Gender	Male	9
	Female	11
Age	<= 30 years	3
	31–40 years	7
	41–50 years	8
	> 50 years	2

3. Results

3.1. Phase 1: Evaluating the agile cocreation method to identify challenges

The evaluation of project documents made clear that the first design of the ACM came with three sets of challenges. The first pertains to securing the active involvement of all users, engineers and user researchers during the cocreation, which was impeded by pragmatic issues (such as unexpected technical failures, mobility and agenda-issues), or cultural issues (familiarity to speak up due to generational differences and perceived differences in status).

The second challenge relates to the different disciplinary backgrounds of the engineers and user researchers, which needed to be bridged. Differences hampered discussions, mutual understanding and decision making when constructing the cocreation sessions based on the expertise of all, and translating user insights into technical specifications. Especially during the creation, validation and prioritization of stories, user insights were often not clear for the engineers, causing problems in translating them to technological features. On the other hand, user researchers were not able to assess if users' wishes were feasible to realize in the available time, leading to misunderstandings about what engineers would build. Hence involving user researchers in the developmental work was daring.

The last challenge pertains to the knowledge management, necessary to employ an evidence-based way of working. Because of the use of a variety of knowledge management tools during the project (e.g., project management software, wiki, document storage platform, shared documents) clarity lacked in the status, content and function of the archived documents. Moreover, the usage of various tools made agility challenging as it was difficult to quickly find the last information that could be acted upon and align information between IT tools during the development.

3.2. Phase 2: Solving the challenges to improve of agile cocreation

During a co-design session, solutions were defined to overcome the forementioned challenges. To further optimize the involvement of all users, engineers and user researchers during the cocreation, we incorporated fun and playful materials, such as cards with statements, programming and roleplaying. These materials bridged the generational differences by facilitating users to express what they wanted from the SARs in an easy way.

To bridge the differences between engineers and user researchers, face-to-face project visits were intensified, data analysis formats were introduced, and fun and playful materials were designed. Physical contact with engaging informal interactive tools, combined with a structured form of data-analysis would presumably enable the mutual understanding needed, open discussion, collaboration, knowledge sharing, and effective use of gathered information about user insights. It could also provide the engineers and user researchers with the time and tools to elaborate on eventual gaps between user's wishes and technical possibilities, and assign tasks to test a new feature to get timely feedback.

Last, we implemented weekly, instead of monthly meetings, to align and exchange information, next to storing it in shared documents and a project management software tool. The continuous communication, and shared knowledge tools should help to work in an agile manner, iteratively and timely. Adjustments to the work could be done in a speedy manner as key 'evidence' was shared in real-time. Fig. 1 shows the Agile Cocreation Method that we created after this phase.

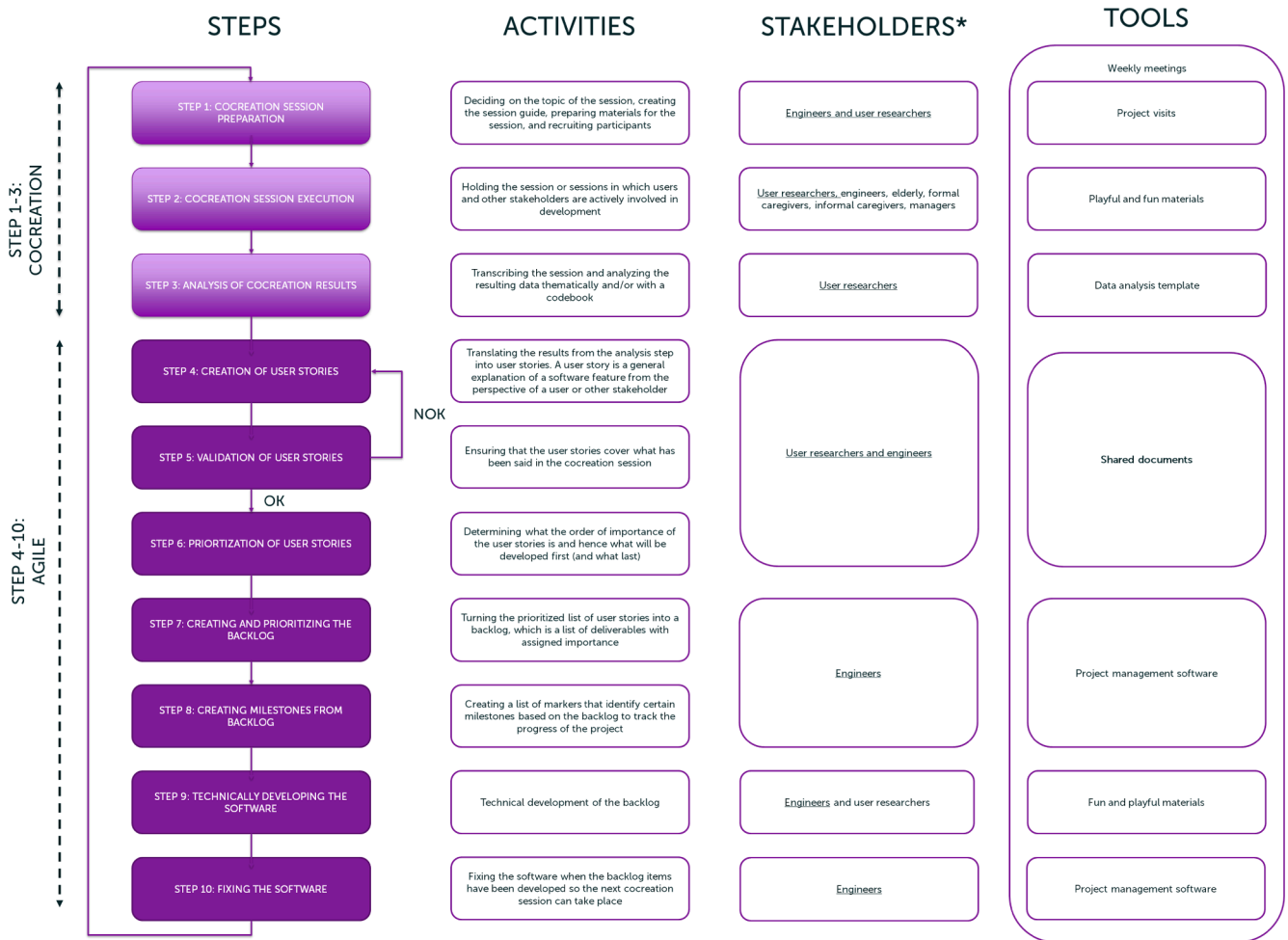


Fig. 1. The Agile Cocreation method. *The stakeholders that are underlined are in the lead in the step, other stakeholders are involved by them when needed.

3.3. Phase 3: Evaluating the usage of the improved agile cocreation method

3.3.1. Characteristics of the respondents

Of the 20 respondents (M = 9, F = 11, age range 27–62), 9 were user researchers (background in marketing, design and health sciences), and 11 were engineers (background in IT development and robotics engineering). Researchers from all participating countries responded (6 from France, 8 from Italy, 3 from Japan, and 3 from The Netherlands). For more information about respondent characteristics, see Table 2.

The level of involvement differed per step and between engineers

Table 3
Level of involvement in steps.

Steps	Involvement		
	Total N = 20 %	User researchers N = 9 %	Engineers N = 11 %
Step 1 Prepare cocreation	75 %	100 %	55 %
Step 2 Cocreation	75 %	89 %	64 %
Step 3 Analyze data cocreation	55 %	78 %	36 %
Step 4 Create stories	25 %	33 %	18 %
Step 5 Validate stories	45 %	44 %	45 %
Step 6 Prioritize stories	35 %	56 %	18 %
Step 7 Create and prioritize backlog	30 %	22 %	36 %
Step 8 Define milestones	25 %	11 %	36 %
Step 9 Development	50 %	33 %	64 %
Step 10 Fix software	30 %	11 %	45 %

and user researchers (see Table 3). As to be expected given the necessary expertise, user researchers are more involved in the cocreation (steps 1–3) than engineers, whereas engineers are the main performers of steps concerning the technical aspects and development (steps 6–10). Steps pertaining to the translation of cocreation insights into the technological development of the SARs requires a more equal distribution of engineers and user researchers, as is seen in the respondent’s involvement.

3.3.2. Use and usefulness of the solutions

Not everybody used the new tools (see Table 4), due to the fact that either they were not involved in certain activities within steps or because of time constraints (e.g., face-to-face visits). Using the playful and fun materials to engage elderly was not always feasible, as it is difficult to capture older persons’ needs and integrate them into

Table 4
Use and perceived usefulness solutions.

Tools	Use (%)	Perceived usefulness (Mean)
Fun and playful materials in cocreation sessions	56 %	4,6
Face-to-face visits	50 %	4,7
Data-analysis templates	45 %	4,0
Fun and playful materials in developmental work	45 %	3,9
Use shared documents	90 %	4,3
Use project management software	45 %	4,0
Participate in continuous meetings	80 %	3,8

technology.

“It is difficult for the elderly to express the true meaning, it is difficult to grasp the needs, and it is even more difficult to drop it into the technical specifications.” (R16).

Irrespective of the reasons, the use of most tools was rather low, and points for improvement were especially given for the project management software and templates. As both need to combine project management data, as well as insights from engineers and user researchers, these tools need to be comprehensive in nature and understandable for all. Given that this was not the case, the tools were not used, misused, or bypassed. Both engineers and user researchers explained that they found it especially difficult to understand each other’s languages, terms, and ways of working through those tools.

“I think the Kanboard tool (project software, red.) was not used by all stakeholders at the same level and not understood.” (R1)

Point of improvement given by R9: “The use of other innovative project management softwares as this kind of software can be used and understood also by non-technical professionals.”

However, those who used the tools found them useful, with answers ranging from satisfied to very satisfied for most tools. According to the respondents the tools improved, facilitated and helped the development and achievements, whilst saving time. The materials and meetings enhanced the quality of the triadic relation between technical requirements, user wishes, and cocreation both in terms of comprehensive and timely communication as in engagement.

“I like to use creative tools during the sessions. I felt it really helped people to express themselves”. (R18)

“Physical meetings prior to co-creation sessions to test the robot and services live are essential (...) this makes it possible to fully understand the services and technical constraints (...), For developers, this allows feedback from co-creators who can be the spokespersons for users and make it possible to improve services”. (R2)

“Using the shared documents and templates has expedited the cocreation development and data analysis.” (R11)

“The continuous communication between all members of the project allows not to waste time waiting for a meeting to have input from a partner.”. (R6)

3.3.3. Solving the challenges

The incorporated tools solved all challenges to a certain extent (see Table 5), making the steps in the ACM relatively easy to execute (see Table 6). The issues regarding the cocreation sessions got a real upward boost as according to respectively 90 % and 80 % of the respondents the stakeholders were more engaged, and both the expertise of engineers and user researchers was better used.

Even though mostly user researchers were involved in the cocreation (steps 1–3), the preparation, execution and analyses were relatively easy

Table 5
Percentage of challenges solved and urgency to still solve challenges.

Challenges	Solved (%)	Urgency solving (Mean)
Engaging all stakeholders in cocreation sessions	90 %	2,3
Translating user insights to technical specifications	70 %	3,4
Making use of each other’s expertise when setting up co-creation session	80 %	3,4
Involving cocreators in development work	55 %	4,0
Aligning information between IT tools during development	75 %	2,7
Understanding and using project management software	65 %	2,8

Table 6
Level of difficulty effectuating steps.

Steps	Difficulty Mean
Step 1 Prepare cocreation	1,4
Step 2 Cocreation	1,6
Step 3 Analyze data cocreation	1,2
Step 4 Create stories	2,0
Step 5 Validate stories	1,4
Step 6 Prioritize stories	1,3
Step 7 Create and prioritize backlog	1,8
Step 8 Define milestones	1,7
Step 9 Development	2,6
Step 10 Fix software	2,4

steps to perform, according to all. Project visits were a useful tool for engineers and user researchers in this, as R2 states:

“Physical meetings prior to co-creation sessions to test the robot and services live are essential to prepare the co-creation and to finalize the facilitation guide. For the co-creators, this makes it possible to fully understand the services and technical constraints, to refine the questions to be asked to users. For developers, this allows feedback from co-creators who can be the spokespersons for users and make it possible to improve services before the co-creation session and avoid certain problems”(R2)

The consequent translation of the insights from the cocreation into technical specifications went better as well, as 70 % deemed this problem solved. However, after the sessions it remained rather difficult to develop the SARs with the user researchers as 45 % still stated this challenge was not solved. Although less than 50 % of the engineers and user researchers were engaged in the steps associated with the translation, and the steps were found to be relatively easy, translating user needs into technological solutions still needs some improvement. So better performing of the creation, validation and prioritization of stories is essential. The project management software that was meant to support the creation, validation and prioritization of stories was mainly used by engineers that had prior experience with it.

“We really only used properly, the whole consortium, the shared files and analysis templates and deliverables. But the Agile Kanboard was only followed by (engineering firm red.) at the beginning and the other partners did not understand and follow it, which is important in terms of Agile methodology.” (R1)

But, the overall exchange, alignment and use of information tools and software has also improved, although understanding the project management software is still difficult.

“The evolution in the CC sessions to this way of work really helps on this, we get more info from users, then the analysis for translation is much more easy and clear by the engineers and cocreators(...). The cocreators could be involved more during development. When we were involved, we were involved via excel. Following Kanboard does not really work for me as I don’t understand it.” (R1)

Even if challenges were solved to a certain extent, still the most urgent ones pertain to bridging the gap between engineers and user researchers. As stated above, in the cocreation steps it is needed to understand the technical aspects by user researchers, and design effective cocreation sessions. For the steps 4 to 6, it is not easy to translate insights from and to different disciplinary fields without a sufficient understanding of the consequences of the needs and possibilities of engineers and user researchers. As R14 states:

“The technological complexity in developing some functionalities is underestimated by cocreators, that consider obvious some functionalities. Developers often don’t fully put themselves in the shoes of cocreators, so the development could appear sufficient and not excellent and then requiring many iterations.” (R14)

Involving user researchers in the developmental work (mainly engineers) remains up for debate. Some find it in urgent need of improvement, as the end goal is developing the SARs.

“The stories, which describe the functional part of the user requirement, need to be written or at least checked by the non-technical part. It is why it is important that co-creators participate to the development process.” (R4)

“We need to understand how to involve cocreators in the development process, since most of the work is technical.” (R8)

At the same time, involving user researchers in highly technical activities they do not understand was not perceived useful and may slow down the work of engineers:

“We need to understand how to involve [user researchers] in the development process [effectively], since most of the work is technical, and sometimes their involvement doesn't speed up the process if we just need to code”. (R8)

When user researchers were involved, this was not done using playful and fun materials. Instead, engineers relied on communication in the weekly meetings. As regards the technical development itself, the engineers indicated that there was too little time to develop the solutions that users requested. As a result, development often ran late, resulting in solutions that approximated user needs as much as possible but having minor technological issues. Technical development and fixing the software (step 9 and 10) hence were perceived as the most difficult by the engineers (mean = 2.6 and mean = 2.4).

4. Discussion

The aim of this study was to investigate the challenges of using a method that combines agile and cocreation in HIT development, and how these can be solved. We find that Agile Cocreation comes with three challenges: engaging all stakeholders in cocreation, bridging the differences between engineers and user researchers and managing the knowledge in the project. Three solutions were found to overcome the challenges: the use of fun and playful materials to engage all stakeholders into cocreation, face-to-face visits and weekly meetings.

Although prior studies on agile cocreation methods exist [9–13], none of these studies specifically focusses on identifying challenges nor on finding solutions. The insight from these studies suggests, in line with our work, that engaging users in cocreation is challenging [8,14,16–18] but that users can be engaged using playful and fun materials [8,14]. Moreover, prior work suggests that collaborating with diverse stakeholders is difficult [14–18], but none of these studies investigate how the diversity of involved disciplines (i.e., user researchers and engineers) helps or hinders in deploying the methods. Prior work also suggests that staying within planning and budget, and dealing with change are also difficult in agile cocreation [15–18]. While we also struggled with these issues, we did not identify them as challenges of agile cocreation in specific. Besides unravelling the greater diversity of challenges and potential solutions, our study contributes to our understanding that not just how users interact with engineers and user researchers, but equally importantly, how different disciplines that interact with each other influence an effective use of Agile Cocreation methods. Hence, when developing HIT through Agile Cocreation methods with different disciplines, specific attention should be paid to the engagement and knowledge sharing between engineers and user researchers.

4.1. Limitations

Our study also comes with three important limitations. The first one is that we investigated a large multi-stakeholder academic project, and findings may not be generalizable to other contexts. Our findings partially align with those of Tassarolo et al. (2022) and Ferrarrio et al.

(2014), who also did research in this context, and that of Kautz (2010, 2011) and Rittenbruch et al. 2002, who focussed on small commercial projects. Nevertheless, future research should verify our findings in these and other context, studying different types of health information technologies. The latter relates to the second limitation of our work, namely, our sole focus on the development of social assistive robots for elderly. As we developed two SARs, ASTRO and Buddy, and three types of applications for these robots (for daily living, conversation, and mobility), we expect that our findings can also be extended to other types of HIT. The third limitation relates to the fact that we focussed on engaging *project team members* in our research. Three of the five prior studies included the perspective of diverse *users* [16–18], suggesting that future research should verify our findings with them as well.

5. Conclusion

In conclusion, this study provides valuable insights into the challenges and solutions of using a method that combines agile and cocreation approaches. The findings show that engaging users in cocreation is challenging, and so is bridging the gap between engineers and user researchers and managing their knowledge. This can be solved by using fun and playful materials to engage all stakeholders, and by having frequent, for example weekly, meetings between engineers and user researchers.

Our findings are relevant for HIT developers that already use or aim to use an approach that combines agile and cocreation in developing user-centered HIT technologies. Our study draws their attention to the challenges of such a combination, next to the benefits that it may have, and offers some solutions to these challenges. Moreover, the findings are relevant for user researchers and engineers: they are encouraged to collaborate and communicate frequently, either digitally or in face-to-face meetings, to ensure that HIT technologies are in line with user needs and to facilitate their quick improvements. For user researchers, our study also stresses the use of fun and playful materials to involve a variety of stakeholders in cocreation, which can be used next to other tools for user involvement.

Finally, our work also highlights the need for more research to generalize our findings. We therefore recommend that future studies focus on verifying our findings in other context, technologies, and with end-users of HIT.

6. Summary table

What was already known on this topic?

- Agile and cocreation are both approaches that consider user involvement in HIT development pivotal.
- Combining the two approaches into one method is promising, but also seems to have its challenges.

What this study to our knowledge?

- Using a method that combines agile and cocreation involves challenges in involving all stakeholders in cocreation, in bridging the differences between user researchers and engineers and in managing their knowledge.
- These challenges can be solved by using fun and playful materials to engage all stakeholders, and by having frequent, for example weekly, meetings between engineers and user researchers.

CRediT authorship contribution statement

Kasia Tabeau: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Visualization, Writing – original draft, Writing – review & editing. **Marleen de Mul:** Data curation, Formal analysis, Funding acquisition, Investigation, Methodology,

Supervision, Visualization, Writing – original draft, Writing – review & editing. **Mathilde Strating**: Investigation. **Laura Fiorini**: Investigation, Software, Writing – review & editing. **Filippo Cavallo**: Funding acquisition, Investigation, Software. **Eloise Sengès**: Investigation, Methodology, Writing – review & editing. **Denis Guiot**: Funding acquisition, Investigation, Methodology. **Estibaliz Arzoz Fernandez**: Investigation, Methodology, Software. **Daniele Sancarlo**: Investigation. **Isabelle Fabbrocetti**: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Visualization, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ijmedinf.2024.105557>.

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