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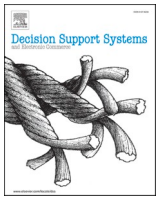

Developers' decision to navigate resource adversity in crowdfunded digital development projects

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ABSTRACT

In a world where funding institutions and venture capitalists dominate the digital product development landscape, crowdfunding engages a global crowd to finance visionary ideas and address underrepresented needs. However, despite recognizing the challenges of managing crowd expectations, there is limited understanding of how developers navigate these challenges following the successful funding of their proposals. Drawing on a comparative, longitudinal, and in-depth grounded investigation, this study illuminates the prevalence of "resource adversity" within crowdfunded digital development projects. Resource adversity, characterized by scarcities of critical resources such as funding and human capital, affects crowdfunded development despite substantial support from a large crowd, potentially leading to complex outcomes. While adversity compels developers to seek additional funding and advocate for changes in various project aspects, this perspective departs from resource-centric viewpoints and emphasizes resourceful decisions to proactively establish resilience, resist precarious changes, and facilitate the release of high-quality products and post-adversity benefits. The perspective contributes to the dominant research focus on post-adversity decision-making and restoration by discussing connections across pre-adversity, adversity, and post-adversity stages. By focusing on preparedness and resourcefulness, the decision-making insights expand research on managing resource-limited development while meeting diverse stakeholder expectations. Moreover, the perspective enriches extant understanding of community-based innovation by elucidating how product improvisation, community resource engagement, and bricolage are interrelated and contribute to shaping evolving digital products. The article concludes by discussing practical implications for entrepreneurs and platform owners and by exploring avenues for future research.

1. Introduction

Crowdfunding has emerged as a viable financing option to support the development of digital products, particularly benefiting ideas with long-term visions and resonating with underrepresented and marginalized groups [42,54]. In crowdfunded digital development projects, a large, diverse, and geographically dispersed group of backers as the crowd decides to fund the development, and the core promise is to create and deliver digital products to those backers. Through crowdfunding, backers contribute financial resources in exchange for the promise of a fully realized digital product[1] [53]. Crowdfunding also enables developers to garner valuable insights from potential users, shaping the trajectory of product development [5,56,73].

Developers, hence, harness crowdfunding platforms' digitally dense and deeply entrepreneurial environments to establish businesses, enhance development, and bring innovative products to life [76]. Although crowdfunded digital development projects are typically initiated by a small group of entrepreneurs with limited experience in resource management, they face tight deadlines and the complex task of managing the expectations of the crowd [21,27,41,84]. Neglecting backers' interests, failing to provide regular progress updates, and showing insufficient gratitude for support can lead to losing backers and damaging their present and future endeavors [88]. While scholars acknowledge these challenges [21,27,41,84], limited understanding explains how crowdfunded developers effectively navigate the challenges after their proposals have been funded. This gap is germane as

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[1] Throughout the article, the notion of "crowdfunding" is focused on reward-based crowdfunding where backers contribute financial support in exchange for rewards such as an early release.

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crowdfunded developers need to respond to the challenges by taking a stance and making well-informed decisions. For example, they may need to change certain aspects of the development scope and deliverables [40,50,62]. The changes could involve prioritizing core functionalities over others and omitting some requirements to solidify essential features. Alternatively, acknowledging their limitations in specific areas, developers may collaborate with established IT companies or industry experts to enhance those aspects. However, effecting such decisions in crowdfunded projects can be complex and disappoint backers, as developers are bound by their entrepreneurial origins and campaign promises [12,21]. This delicate nature of changing certain aspects of crowdfunded projects underscores skillful strategies to maintain backer support while responding to unforeseen complexities in the development process. By exploring and revealing these strategies, researchers contribute to a better understanding of how crowdfunded developers' decision-making can be leveraged to tackle their challenges. This knowledge can enhance public trust in crowdfunding proposals, supporting talented entrepreneurs and fostering the emergence of innovative ideas through this contemporary approach to digital developments [24,84].

Against the backdrop of these opportunities, this study explores decision-making dynamics within crowdfunded digital development projects aimed at tackling development challenges. More formally, the study explores: How do crowdfunded developers make effective decisions, which may involve changing certain project aspects, to overcome developmental challenges while avoiding complicating dynamics? Through an in-depth, grounded investigation of two crowdfunded projects, this study uncovers the developers' resource-based challenges, especially the constraints related to finances and human capital. This finding challenges the assumption that crowdfunded projects, given their widespread and public support, are exempt from resource limitations [9,91]. Integrating the findings with development research, this study presents a perspective that explains the prevalence of resource adversity in crowdfunded projects. Unlike resource-based views that dominate the focus of both digital product development and crowdfunding research, the perspective emphasizes the distinction between developers' need for more resources and their resourcefulness to pursue effective changes [3,11,74,87,93]. This resourcefulness differs from common approaches that consider transforming plans and approaches a reasonable strategy to development challenges [40,50,62]. Instead, the study elaborates on strategic decisions that developers employ during fundraising and development to plan for resource adversity, practice resilience and resistance to risky changes, and implement only changes that foster the release of high-quality products and post-adversity benefits. The perspective's decision-making insights, beginning with thoughtful planning early on and further advanced during development, make valuable contributions to research that promotes sustainable outcomes in crowd-based projects [21,24,26,82,84]. Moreover, by emphasizing pre-adversity and digital product improvisation, these decision-making insights enhance the study of organizational responses to adversity [70,85] and community-based innovation, encompassing the identification, combination, and amplification of limited resources [95].

2. Crowdfunding for digital development projects

Crowdfunding is an important, contemporary source of support for digital projects, enabling technology-enabled innovations such as virtual reality, multi-player applications, and 3D printers [4,42]. It has become an alternative solution to the resource constraints faced by developers who traditionally rely on stakeholder funding [8,36]. By leveraging a global network of backers, developers also solicit contributions for software debugging, compiling, and expanding digital features [42,56,73].

Given these benefits, crowdfunding research's dominant focus has been fundraising [34,71,92]. A significant body of research has examined factors influencing fundraising performance [37,44,81]. This research is grounded in the resource-based view, which underscores the significance of acquiring tangible and intangible resources to leverage competitive opportunities [1]. As prospective backers make funding decisions based on their perception of project outcomes [16,33], researchers have explored how developer characteristics, linguistic choices, and communication strategies influence crowd behaviors [37,44,58,81].

Scholars, however, challenge the dominant focus on *more resources* by highlighting the challenges developers face once their proposals have been funded [12,27]. Open-source development is similar, involving external groups contributing to online activities [17,46,52]. However, open-source projects typically have some flexibility regarding timelines and deliverables and involve a larger community of contributors. In contrast, crowdfunded projects define public deadlines and goals and are typically implemented by small teams with limited experience. Such unique characteristics exacerbate crowdfunded developers' challenges in meeting expectations and delivering products within a specific timeframe.

But, although implementing change is often considered a reasonable strategy in the broader development literature [40,50,62], crowdfunded developers must maintain a delicate balance to sustain backer support. As they rely on financial support from backers with stakeholder expectations regarding project timelines, features, quality, and partnerships [27,94], critical changes such as dropping features or establishing partnerships trigger a sense of ownership in backers and cause tension in developer-backer relationships [25,27]. Similarly, developers may require partners to contribute additional resources, but backers may perceive those partners as compromising the project's independence and values. Backer dissatisfaction generates negative reviews and damages developers' public image, potentially affecting their future initiatives [21]. It is, thus, essential to investigate how crowdfunded developers can make effective decisions, including changes to some aspects of their project, to maintain overall back support while addressing key development challenges to progress toward product release.

3. Research method

This research investigation requires exploring crowdfunded developers' experiences and reflecting on their actions and project outcomes. This study, therefore, adopts an interpretivist case study methodology, which is suitable for exploring human experiences and the meanings attached to emerging actions and outcomes [19,30]. A longitudinal approach is also applied, covering both *development* and *fundraising* to delve into developers' approaches to change and their ability to manage relationships and move toward product release [39,90]. The research drew upon the case study's emphasis on polar sampling to uncover the intricacies of decision-making in crowdfunded digital development projects. This included deliberately selecting cases—*Shovel Knight (SK)* and *Clang (CL)*—that represent different ends of the spectrum in terms of project outcomes and responding to the challenges crowdfunded developers face. While the SK developers achieved exemplary success in crowdfunding and game development, the CL developers could not complete the project, overwhelmed backers with their communication, and blamed the community for lack of support. By examining these notable projects that encountered critical challenges but had contrasting levels of success and failure, the study can reveal variations in how the developers respond to adverse situations and how their decisions impact the project's success.

3.1. Data collection

Multiple sources were considered to investigate the cases. Importantly, the data collection process is guided by emerging findings, which align with a grounded approach and allow for gradual sensemaking of the data. Specifically, the process began by identifying the projects'

milestones, including the launch of the campaigns, successful funding, and product releases. After drafting a timeline for each case, three phases of data collection unfolded, focusing on (1) campaigns, (2) developments, and (3) outcomes (Table 1). For this, the data was gathered from sources such as campaign pages, developer updates, backer comments, community discussions, post-release reflections, online articles, and press news (Table 2). This diversity helped triangulate data and comprehensively understand the developers' experiences and activities. While the data did not include direct developer interviews, complementary sources were leveraged. This included detailed developers' published project diaries, reports, public communications, and post-release reflections, providing insights into the developers' challenges and decision-making dynamics.

3.2. Data analysis

Analyzing and interpreting the data from the cases, as outlined in Table 3, involves within-case analyses, cross-case analyses, and theory development [18]. Following the principles of grounded research, this approach led to identifying first-order codes, second-order concepts, and conceptual insights. Table 4 presents the data structure and compares the cases across the concepts and dimensions.

Significant care was paid to ensuring the reliability and validity of the analysis. The first challenge is descriptive validity, relating to the factual accuracy of the data gathered and reported [49]. This risk was managed by including rich statements and providing examples of coding processes [29]. Further, the data used in this study are taken from open and publicly available discourse. The second challenge is reliability, relating to authors' ability to reproduce the theorizing process and arrive at similar results [59]. This risk was managed by leveraging two research assistants and several consensuses to reach a consensus of potentially diverging interpretations. Triangulation was also used between central and less-central online sources and between online articles and online interviews with the developers to corroborate findings and inform theory building [13]. The third challenge is construct validity, which establishes robust links between data and theoretical categories [90]. This risk was reduced by using pre-existing concepts from various streams of literature on crowdfunding, software development, and entrepreneurship. The rich availability of data from different sources also lent to 'prolonged engagement with the field', suggesting that discourse could be revisited during iterations of data collection for new insights. The final challenges are *internal validity* [90] and external validity [29]. The risk to internal validity was managed by linking observed patterns with established ideas, i.e., literature on bricolage, resourcefulness, and open innovation. The risk to external validity was managed by linking the findings to existing theories in multidisciplinary literature on development, entrepreneurship, and resourcing [23].

Table 1
Data collection process.

Phase 1: Campaign data	Information available on Kickstarter's SK and CL crowdfunding pages before the development stage: funding details, reward structures, stretch goals, updates, announcements, comments and responses, and community discussions. This data is critical in identifying the fundraising foundation of the projects, which can influence how developers respond to challenges. Before the development stage: funding details, reward structures, stretch goals, updates, announcements, comments and responses, and community discussions. This data is critical in identifying the fundraising foundation of the projects, which can influence how developers respond to challenges.
Phase 2: Development data	Information available on Kickstarter's SK and CL crowdfunding pages before the projects' official releases: progress updates, comments and responses, and all other community discussions. This data is critical in identifying the nature of the developers' challenges and their responses, such as changing or resisting change.
Phase 3: Project outcomes (and additional data for fundraising and developments)	SK and CL are public stories both in their fundraising and development. As they gained the media's attention through news, online forum discussions, and press releases, it was possible to explore various outlets posting information about them. We, thus, use the Google API Explorer tool to identify and extract additional public posts and comments related to their fundraising and development process. This data sheds additional light on the projects' fundraising foundations and how the developers revisited their works in response to the challenges.

Table 2
Collected data overview.

	SK	CL
#Raised Funds	$311,502 out of 75,000	$526,125 out of 500,000
#Backers	14,749	9023
#Team size	**6**	**6**
Fundraising	**March 15, 2013-April 14, 2013**	**9 June 2012–July 10, 2012**
#Developers' Extended Updates	18	22
#Comments (backer/developer)	578	432
Development	**April 15, 2013-June 28, 2014**	**July 10, 2012-Sep 18, 2014,**
#Developers' Extended Updates	29	21
#Comments (backer/developer)	2745	2707
Post-release	**June 29, 2014-Dec 10, 2019**	**–**
# Developers' Updates	27	–
#Comments (backer/developer)	264	–
TOTAL		
# Developers' Extended Updates	**74**	**43**
#Comments (backer/developer)	**3587**	**3139**
Online interviews/posts/press	**42**	**34**

4. Empirical findings

4.1. SK case

On March 15, 2013, Yacht Club Games proposed SK on Kickstarter to build a classic adventure digital game with memorable characters and an 8-bit retro aesthetic. A team of six developers initially asked for a modest $75 k to create their product, knowing that the amount collected was unlikely to meet the total project cost. Meanwhile, the data suggests that the developers' fundraising strategies prepared the team for mitigating the resource adversity that emerged during development.

First, SK did not overpromise digital features to attract more finances but instead promised attractive features as "stretch goals" if they hit specific financial targets. However, the developers postponed the delivery of those stretch goals until after the official release based on the assumption that the first release would sell and fund post-release activities. By offering attractive and reasonable stretch goals, they enticed 14,749 people to support the campaign and raised £311,502,

Table 3
Data analysis process.

	Timelines of notable events for each case
	• Creating a contact summary sheet for each case to organize thoughts and illuminate the timeline of key issues. • Creating a longitudinal story of significant challenges and activities during each case.
	First-order codes
	• In-depth content analysis of the data to understand how SK and CL engaged in fundraising and development, including the challenges faced and how they were to proceed toward official release. • Data was coded by identifying 64 first-order codes, encapsulating ideas related to project challenges, developers' responses, and project outcomes.
	Second-order concepts
Within-case analyses	• Comparing and clustering codes and sources to shift the analysis from data-level expressions (first orders) to researcher-centric elaborations (second orders and dimensions). • The first-order codes were organized into 13 categories of second-order concepts, as shown in Table 4. Those concepts were further condensed into higher-level theoretical dimensions. For example, some codes suggested that SK had **underestimated** (internationally) the project to fund the game on Kickstarter. During development, they had limited money to continue the project (e.g., paying team members' salaries and office bills). Others suggested that CL discovered during development that they could not access sufficient testers. Building the related AI features was **complex** in light of limited testing resources. Those codes were clustered as **funding underestimation** and **development complexity**, respectively, linked as the roots of resource adversity faced by the projects and coded under the resource adversity dimension. • Creating a comparative understanding of how SK and CL experienced resource adversity, their responses, and diverse project outcomes. • Creating an understanding of how developers' approaches might have created a foundation for contrasting outcomes.
Cross-case analysis	• Explaining fundamental differences in how SK and CL activities played a role in addressing resource adversity. This included considering (1) **fundraising strategies** to prepare or mitigate resource adversity, and (2) **development strategies** to respond to adversity by resisting risky changes (downsizing development scope and deliverables) and/or implementing effective changes (redefining team values and expectations, exposing struggles and solutions, and innovating with external communities). • Leveraging the findings and insights from extant research to triangulate the meanings and elaborate on the relationships between different concepts and dimensions (e.g., resource adversity, decision strategy, decision areas, project outcomes).
Theory development	• Outlining a perspective on how crowdfunded developers experience resource adversity but can effectively plan, resist risky changes, and implement only effective changes to proceed toward product release, maintain positive relationships, enable post-release developments, and build post-adversity capabilities.

considerably more than their initial target of £75 k. This stage-based approach also enabled the developers to concentrate on creating a robust version of their product, with ample time to work on each feature of the stretch goals post-release. As evident, the developers released various updates that enriched the SK experience and posted progress reports until December 10, 2019, which showcased how the stretch goals had expanded beyond the initial project.

Second, the SK reward system reflects the developers' enthusiasm to involve the crowd during development. Backers who pledged $75 or

Table 4
Data structure.

Empirical Evidence	Concepts	Aggregate Dimensions
SK developers deliberately chose a modest fundraising target, and although they collected more, the funding was still insufficient.	**Fundraising underestimation** refers to the deliberate or unintentional underestimation of the fundraising goal, causing a scarcity of critical resources and hindering the project's progress.	**Resource adversity** refers to where developers face a scarcity of essential resources to fulfill their campaign promises.
SK developers noted diverse backer requirements, creating complexity that required more funding. CL recognized the challenge of building AI features with a limited user pool and sought funding to extend the project and explore alternatives.	**Development complexity** refers to challenges during development, demanding additional resources. When developers cannot acquire those resources, they face a scarcity of resources, hindering their progress.	
SK included stretch goals and staged delivery to attract more funding and to break down complexity. The collaborative rewards also enabled backers to contribute during development.	**Planning for adversity** refers to developers' strategies to mitigate the severity of resource-related challenges and create a community-based foundation for overcoming future adversity.	**Decision strategy** refers to crowdfunded developers' high-level approaches to address and optimize project outcomes despite limited resources.
SK resisted changing the scope, which could have complicated development.	**Resisting risky changes** refers to developers' decision to avoid changes that alleviate resource constraints but can conflict with developers' values and commitments.	
Both projects made changes, as below.	**Implementing effective changes** refers to developers' actions to address resource constraints and their adverse effects on project outcomes during development.	
CL downsized the scope and deliverables from building a functional game to a demo.	**Refining development goals and deliverables** refers to updating the project scope and deliverables.	**Decision area** refers to key high-level project aspects that crowdfunded developers choose to change in response to resource adversity.
Both SK and CL campaigns expressed the developers' skills. Under adversity, SK developers focused on radical entrepreneurial values and postponed their salaries to post-release. CL shifted to prioritizing the financial expectations of an established team.	**Redefining team values and expectations** refers to changes in how developers behave to highlight their values, skills, and expectations.	
SK developers reinforced the fundraising invitation to welcome speedrunners to contribute. CL resisted to collaborate with the communities of expert backers.	**Innovating with external communities** refers to fostering software enhancements through a process of product improvisation and bricolage with external communities.	
When faced with adversity, SK developers discussed struggles and	**Exposing struggles and solutions** refers to changes in developers' communication style	

(*continued on next page*)

Table 4 (*continued*)

Empirical Evidence	Concepts	Aggregate Dimensions
brainstormed with backers.	with backers in relation to discussing challenges and potential solutions.	
SK was released with high-quality standards. CL development was halted and failed.	**Product release** refers to delivering the product as promised during a crowdfunding campaign.	**Project outcomes** refer to the short- and long-term implications of a crowdfunded digitaldevelopment project for developers and the crowd.
SK fostered positive relationships with backers and speedrunners. CL led to disappointment and a sense of betrayal among the backers.	**Project relationships** refer to the quality of interaction between developers and the crowd.	
SK advanced the product through post-release updates. CL did not establish a post-release foundation and could not deliver future enhancements.	**Post-release enhancements** refer to ongoing improvements and updates that developers make to the product after the formal release.	
SK resistance and changes led to resilience and an international profile. CL considered the project a waste of time.	**Post-adversity capabilities** refer to qualities and skills that developers build while overcoming adversity.	

more were promised opportunities to participate in design meetings and Google Hangouts. The collaborative reward structure attracted 375 enthusiastic backers who later provided free suggestions, assets, and beta testing, which enhanced the developers' productivity and helped them navigate the adversity that emerged during development.

Following the successful crowdfunding campaign, SK released a progress update on April 14, 2013, reassuring backers that they were committed to delivering on their promises. However, the developers discovered the complexity of catering to backers' diverse preferences and the challenge of promoting the game on various social media platforms. While they required additional funding to ensure their efforts aligned with backers' expectations, they had already raised an unrealistic amount for the base project.

Despite these obstacles, the team was committed to delivering the original scope of the product and received positive feedback from their backers. While this approach demonstrated resistance to changing the core development scope and deliverables, it posed challenges as the team consisted of only six developers with limited experience. Therefore, the team decided to make other changes to address the adversity. The first key decision was redefining the team's values and expectations, which reflected radical entrepreneurial behaviors. During the fundraising campaign, SK developers presented themselves as experienced game developers. However, after the campaign, the developers adjusted their team expectations and demonstrated strong entrepreneurial values. They worked tirelessly for five months without salaries and deferred remuneration until after the digital product was released. This highlighted their dedication and commitment to the project's success despite facing financial challenges during development. A developer shared a post on Gamasutra on August 5, 2014, highlighted.:

> *"It was a passion project! We didn't care if we had to sacrifice ourselves to do it. It ended up operating for five months without money or payments to the team, and some of us were awkwardly standing in front of cashiers having our credit cards declined."*

In addition, the developers honed new capabilities in developing, promoting, and marketing digital products. This enabled them to rely on delayed rewards and go the extra mile to overcome adversity toward releasing a high-quality product:

> *"We learned some new things and have a wealth of ideas for how we can improve on in the future. We had done a lot of promotion and marketing at conventions and on media sites to prove ourselves over the course of the year, and we think people responded to it in kind!"*

The second key decision was updating the communication style. During the fundraising campaign and early development, SK leveraged the crowdfunding platform to share success stories and positive news. Following the adversity, they focused on exposing struggles and brainstorming with backers for possible solutions. This approach allowed them to maintain transparency. Meanwhile, they continued to maintain a constructive approach by applying Kickstarter, Steam, Twitter, and other social media platforms to encourage backers to contribute to product design and development:

> *"If you have a controller that doesn't work with Steam [digital platform to collaborate with the crowd], you can go here to help us: Controller Binding Page."*

> *"Collaborate with designers and programmers to create and implement assets. Provide feedback on how to improve tools and increase team productivity."*

By involving enthusiastic backers in these activities, SK gained better resources to build the official release and establish stronger bonds with their supporters. One backer shared their positive experience of participating in design meetings in the community section, stating seeing their ideas implemented in the game made their involvement rewarding. Understandably, on May 14, 2014, backers showed support for SK's decision to delay the update due to the adversity they were facing, expressing a commitment to ensuring product quality:

> *"When the team is exhibiting concrete proof of their labors to make Shovel Knight a truly memorable game, I'm thrilled to wait a little longer to ensure the quality of the final product."*

The third key decision was the expansion of the team's community-building efforts to collaborate with external communities beyond the original backers. Speedrunners, who specialize in completing games quickly and exploiting various techniques, became engaged with SK due to the team's positive communication with backers. The team recognized the potential of speedrunners as unexpected resources to enhance the product.

To reinforce and cater to the speedrunners' needs and appeal to their expertise, the developers improvised by adding new features, such as a timer to record completion times. Subsequently, the input and feedback from speedrunners enriched the developers' resource base, which was combined with their own insights to identify critical bugs and incorporate innovative features that appealed to both speedrunners and backers as initial users. An example of this collaborative effort was the addition of a "Reset" button, inspired by feedback from speedrunners. This feature allowed players to restart a level without exiting and reloading the game, enabling speedrunners to practice specific sections more efficiently. The result was the discovery of new routes and an enhanced overall user experience for all players. Through improvisation, SK tapped into and tapped into and attracted the expertise of this external community that was combined with the developers' existing resources.

Collectively, the team's fundraising strategies, such as utilizing stretch goals, enabled them to attract more realistic funding, manage the development complexity, and collaborate with the backer community post-release. Further, the team's focus on their promises, adoption of radical entrepreneurial behaviors, and collaboration with backers and external communities enabled them to overcome resource adversity and transform it into opportunities for growth. After 15 months of dedicated teamwork, SK was finally released to their backers on June 28, 2014. The game received critical acclaim and was featured on several Game of the Year lists.

4.2. CL case

On June 9, 2012, Subutai Corporation launched a Kickstarter campaign for CL, a sword-fighting video game aimed to revolutionize the gaming industry. The campaign's goal of £500,000 raised £526,125 from 9023 backers on July 9, 2012. However, like with SK, the CL case highlights the resource adversity that crowdfunded digital development projects can face due to insufficient finances and development complexity.

Specifically, the CL team—involving five developers and the project owner—encountered unforeseen development challenges. One significant challenge arose when the developers realized the necessity of a larger pool of testers to create play scenarios, but they could not access such resources. In an update, CL expressed concerns that the initial group of users might face difficulties finding game partners to play with, potentially leading to frustration among backers who owned the game but could not engage in gameplay. As a result, the developers had to explore and assess alternative options. However, their initial efforts proved unsuccessful, and they needed additional funding to extend the project. As they could not secure the financial capital required, they decided to make significant changes to the project in response to their struggle with insufficient finances.

The first key decision was downsizing the development scope and deliverables from creating a fully functional digital game to just a demo. This change disappointed backers who had expected a finished product for their investment. One backer expressed that a demo did not reflect an investment of over $500 K and that many other digital projects had achieved more with less funding. Backers also noted that CL had been advertised as a finished product, not a demo, and that calling it a demo at this stage was misleading:

> *"I never recall Clang being advertised as a demo, but as some kind of a finished product - even if the minimum goal would leave the product in a rather bare state. To call it a demo at this stage is a bit misleading."*

Some backers questioned the legitimacy of CL's fundraising direction after the campaign, accusing the team of moving outside the initial promise:

> *"You stated that you would raise further funding after the prototype was made, but now you say that you were doing it from the start? This falls way outside of the scope of the project. You have deceived all your backers."*

The CL's second key decision was to redefine their team values and expectations. Unlike the SK team's radical entrepreneurship behaviors, CL shifted their presentation from a team of entrepreneurs to an established group focused on continuing to exist, even if they could not complete the project. This shift differed from their original message during the campaign that they cared about creating a finished product. It was reflected in a post on CL's Kickstarter Community, emphasizing the importance of salaries and supporting Subutai Corporation:

> *"This is not a case of creating a start-up company from scratch as part of a Kickstarter. Our payroll processing company required a certain minimal "keep alive" payment. Of course, salaried members of the Clang team had to participate in fundraising activities."*

The third key decision was related to using the crowdfunding platform to communicate with backers. During fundraising, the developers provided frequent updates, acknowledged backer feedback, and engaged in the comment section. Upon experiencing development challenges and, in turn, resource adversity, they rarely used the platform and did not respond to backers' comments, resulting in frustration among backers. Specifically, after a few updates from February to April 2013, the developers lost confidence and stopped releasing posts on the platform for over five months. Upon returning, they made comments that disturbed backers, such as blaming backers for passive participation, and framed their updates in ways that reinforced the idea of building a demo than delivering the promises. This communication created negative feedback among backers, who demanded apologies and acknowledgment of the failure to deliver the product:

> *"I find it wholeheartedly disappointing that [developers] are coming off as if they delivered the bulk of the promised product with the demo."*

The developers further responded to criticism with conflicting statements. Although they initially confirmed that the full game would be released, they did not follow this commitment and reiterated that they only built a demo. They even attempted to adjust backers' expectations, stating that the Kickstarter plan was never for a full game:

> *"Todd, sorry, but the plan for Kickstarter was never a full game, though many read it that way, which is why we are attempting to adjust expectations."*

Facing disappointed backers, the developers issued an apology but continued to stick to their decisions, further upsetting the community. When they issued another apology on September 19, 2013, it was defensive in tone and did not satisfy backers who suggested that regular updates, even indicating that work was being done, would have been preferable to silence:

> *"The worst possible update is no update at all. They don't have to be long updates, but they let the backers know that the project is still there, and someone is doing something."*

It is worth noting that the CL team missed a critical opportunity. Unlike SK, CL's campaign only offered backers early access to the first release, physical rewards such as posters, and a chance to visit the developers' studio. They did not open pathways for backers to participate in design and development. When the project encountered AI-related challenges, the developers had limited funding to look for solutions. Some backers pointed to the open-source community that could be involved to help overcome CL's struggles. However, the developers did not leverage collaborative arrangements with external communities to aid the adversity they were facing. As the project progressed, they prioritized financial support and highlighted that only more funding could help. Experienced backers understood the failing signs and suggested opening portions of the source code so those familiar with hacking techniques could collectively build CL. Still, the developers did not commit to productive collaborations and co-creating ideas, fearing they would conflict with their business objectives:

> *"Don't string this project along on the nights and weekends plan when you could just make your efforts available to a broader set of possibly enthusiastic and talented developers that may find a way to make consumable use of those efforts."*

On September 18, 2014, the CL team finally announced that the project would not continue due to a lack of funds. This was after a year of no updates, during which the developers focused more on their establishments, communicated irregularly and defensively about major changes in development scope and deliverables, and failed to acknowledge and collaborate with the community. As a result, CL could not fulfill its campaign promises or establish a foundation to create and advance the product.

4.3. Cross-case comparison

SK and CL launched campaigns that generated significant funding from many backers. Both projects started with small teams and a focus on delivering digital features while engaging with the community. However, both faced resource adversity, making delivering on their product release difficult. Table 5 summarizes the similarities and differences across the key dimensions of resource adversity, decision strategy, decision areas, and project outcomes.

Table 5
Empirical summary.

	Both development teams faced limited funding and human capital for their projects.
Resource adversity	1. *SK* encountered complexities, given backers' diverse preferences, that were challenging to address since the developers had already underestimated costs and struggled with finances due to a small team working long hours. 2. *CL* faced complexities in building features, which were challenging to address since the team could not attract more funding to look for development solutions.
Decision Strategy	1. *Planning: SK* fundraising alleviated resource adversity: Stretch goals and staged development attracted more funding for the base product and broke development complexity into manageable stages after the initial release. Rewards created a foundation to attract and benefit from collaborative arrangements with backers during and after development. In contrast, *CL* fundraising had no defined stretch goals, stage developments, and rewards for collaborative arrangements with backers. 2. *Resistance*: *SK* resisted risky changes to development scope and deliverables when facing resource adversity. In contrast, *CL* significantly reduced the development scope and deliverables. Meanwhile, the developers resisted backers' invitations to collaborate with them and external communities to help overcome the adversity they were facing. 3. *Changes: SK* and *CL* implemented changes in the following areas:
Decision area	1. *SK* practiced radical entrepreneurial behaviors, revisited their communication to expose struggles and engage backers in possible solutions, and improvised product features that created opportunities to collaborate with speedrunners and combine their resources with the developers' existing resources. 2. *CL* downsized the development scope and deliverable, shifted team presentation from a group of entrepreneurs to an established team with financial expectations in normal situations, and adopted a silent and defensive communication style that blamed backers and focused on highlighting small achievements as the campaign promise.
Development outcome	1. *SK* achieved a high-quality product release that sold well, with positive relationships and engagement from an expanded network of backers and speedrunners, various post-release updates and enhancements. The team also expressed building post-adversity networking and social capabilities for collaborating with the crowd in building products. 2. *CL* did not achieve a product release beyond a demo, with negative relationships reflected in backers' expressions of regret in making investments and tension in developer-backer communication. Clearly, there was no post-release update, and the developers considered the project a waste of their time.

5. Discussion

Although researchers acknowledge the challenges of managing crowd expectations [21,27,84], limited research explains how developers navigate those challenges once they have received or even exceeded their targeted funding. This research examined projects that initially attracted high levels of support from the public but later dealt with resource adversity arising from limited funding and human capital.

This finding challenges the positive finance-related perceptions about well-funded crowdfunded projects [9,91], indicating that these projects may still encounter resource adversity. Specifically, crowdfunded projects tend to request less money than traditionally funded projects to align with the industry norms that value modesty and resourcefulness [47,53]. Like the SK case observations, the underestimation leads to inadequate funding and adverse experiences to complete product development. Crowdfunding platforms also take a commission on the funds raised [20,83], resulting in less capital than anticipated, leading to further resource adversity. Moreover, crowdfunded projects typically operate with small teams [6,64] and must adhere to promised timelines to meet the crowd's expectations [14]. Nevertheless, developers strive to maintain regular communication to sustain backers' support and goodwill. Furthermore, digital products, such as software, require continuous refinement and adaptation to be compatible with emerging platforms, adding to the complexity of development [10]. During development, unexpected technical issues, such as software bugs, can arise, leading to crashes and malfunctions that require attention and cause delays. Addressing compatibility issues that were not initially anticipated also consumes time and necessitates resources, such as specialized expertise or tools. Indeed, the empirical cases highlight some of these complexities. CL encountered the challenge of building AI-driven features in multiplayer game development, with limited funding to establish the necessary expertise to address this complexity., SK also realized the need to consider the diverse preferences of backers in collaborative development but faced constraints due to limited funding in completing the product.

In summary, crowdfunding provides a helpful source of funding for digital projects. However, aiming for a large community of backers with innovative ideas exposes developers to norms and challenges that require additional resources, especially more funding and expertise. Failure to secure these resources leads to adversity, disrupting developers' performance. These findings correspond to extant research on development challenges in crowdfunded settings [21,27,84]. However, the findings expand existing conversations by highlighting that the outcomes of adverse situations can vary based on how developers' resourceful decisions can transform the challenges into opportunities for innovation and growth [3,74,87]. Below, the article explains how developers' decision-making can include proactively planning for adversity, resisting risky changes, and implementing effective changes.

5.1. Planning for adversity

Organizations decide to respond to resource constraints with effective changes deemed necessary [2,61,86]. Crowdfunded projects, however, are constrained by their campaign promises to avoid disappointing backers and losing their support [12,21].

Consistent with established risk mitigation perspectives in digital projects [22,48], the findings indicate that crowdfunded developers can anticipate resource-related challenges and adopt strategies that alleviate the adversity that may arise during development. Such a proactive approach, *planning for adversity*, mitigates the severity of resource-related challenges and creates a foundation for leveraging that inevitable adversity. Like the SK case observations, developers can employ stretch goals as a fundraising strategy. Stretch goals attract more backers and secure the necessary finances for the promised release. This mitigates the severity of resource-related challenges. The initial mitigation is critical because if the levels of adversity during development turn high, developers likely lose hope and de-emphasize the probability of achieving any successful outcomes [32]. Integrating stretch goals with staged-delivery techniques allows for a comprehensive product development vision that captures the financial support of potential backers. Additionally, deferring the delivery of stretch goals to the post-release stage helps prioritize a higher-quality release.

Furthermore, developers can plan to nurture a resourceful community-based foundation to mitigate adversity and grow during and after resource-constraints periods. While development environments such as open-source communities face challenges sustaining user contributions [69], crowdfunding offers a valuable opportunity to cultivate community management through co-investment and establishing a crowd-based foundation [57,65,68]. This can be achieved through *collaborative reward structures* with targeted incentives tied to specific financial pledges. Developers can offer privileged early access and the opportunity to test the digital product and provide feedback to backers who have made specific pledges. This creates a resourceful community-based foundation to enhance developers' productivity as they face

resource adversity. It also fosters participatory development and nurtures collaborative relationships with backers to serve as product advocates. Those backers can offer long-term support beyond the formal release, contributing to future product enhancements [75].

5.2. Resisting risky changes

Crowdfunded developers may encounter expertise limitations or budget constraints in the development stage. This struggle with resource adversity prompts them to contemplate modifications to their goals and deliverables. For example, the team could consider changes such as reducing the functionalities to simplify certain aspects and reduce costs. However, as discussed, these decisions may not align with the expectations of all backers, resulting in their frustration. For example, by compromising the accessibility vision promised to backers, developers can lose backers' trust. Therefore, crowdfunded developers should resist critical changes to avoid complex outcomes, including disappointing backers and straining developer-backer relationships. This resistance reflects the hesitation to implement modifications that could alleviate resource constraints but contradict their values and commitments. Instead, by prioritizing values and commitments, developers uphold accessibility standards.

Such resistance is a form of resilience, as developers aim to maintain community trust and support [89]. In the case of CL, the developers decided to pursue critical changes to development goals, leading to conflict with backers. In contrast, SK developers exercised caution when changing their core promise, ensuring that modifications aligned with their initial commitments. This resistance to changing their vision and core product features helped maintain trust and avoid disappointing backers. However, developers still rely on implementing alternative changes to mitigate the inevitable adversity.

5.3. Implementing effective changes

5.3.1. Redefining team values and expectations

Research abounds about entrepreneurs bundling existing resources and offering novel solutions to turn resource shortages into a source of advantage [61,93]. The findings resonate and imply that the developers' decision to "make do" with their resources—even when these resources do not meet the standard requirements—can serve as a fundamental resource. Specifically, the CL developers decided to rebrand themselves as an "established and experienced development group," demanding higher financial expectations from the project. In contrast, SK developers reinforced and further expanded their earlier emphasis on being a group with expertise in digital game development to a group of entrepreneurs who did not have the option of giving up on their passion for building the product. Notably, they engaged in unconventional steps, such as postponing all team members' salaries to the post-release stage. Such radical entrepreneurship behaviors demonstrate a commitment to redefining expectations toward completing a crowdfunded project.

By adopting those behaviors, developers are more likely to stretch their existing capabilities and make the most of the critical resources available. This finding aligns with the resourcefulness perspective, suggesting that individuals' effectiveness in leveraging their internal resources—notably themselves—enables them to overcome resource-based constraints [74].

Moreover, as developers effectively communicate entrepreneurial values and choices, they make a positive impression on the crowd. Hence, backers are more likely to empathize and offer additional support. Furthermore, the resilience to navigate adversity encourages developers to practice the freedom to do things differently, break norms, and act creatively. They likely build new skills and end up in a more competitive position. This "better off post-adversity" outcome is consistent with posttraumatic growth, which describes how positive changes can occur due to the struggle with highly challenging circumstances [7]. As a case in point, the SK developers expressed establishing experience in crowd engagement and completing complex digital games, whereas the CL developers considered the project a waste of time.

5.3.2. Innovating with external communities

Resource-constrained environments motivate individuals to creatively combine available resources through trial and error, exploring new opportunities that may not have been pursued otherwise [3].

As crowdfunded developers face resource adversity, their access to a community of enthusiastic backers allows them to support bricolage activities—to make do by leveraging backers' resources such as feedback and testing support [15]. However, given crowdfunded projects' time constraints, developers need to quickly explore the potential within the community and foster productive arrangements. The findings illuminate the role of product improvisations in attracting new resources from external communities and leveraging them alongside existing resources to address resource adversity and progress toward product release.

Developers can improvise to convert "passive backers" into "active contributors." Developers, for example, can run community calls and contests to reward the most innovative product ideas and solutions that require specific expertise and time. Backers, especially those with diverse backgrounds, will likely offer creative solutions to complex issues, allowing developers to engage in bricolage as a deliberate and strategic approach to resource scarcity [15]. Even though developers do not select those ideas, contributing backers will be encouraged to participate in future initiatives [60]. By involving backers, developers foster a shared vision of beneficial alterations and create a greater tolerance for change, even if the changes deviate from the fundraising plans. In contrast, if backers only engage at the beginning and end of a project, as observed in the CL case, they may find unexpected changes disruptive.

Consequently, these community engagements reinforce a network of backers who actively share their excitement and raise public awareness about the project. As these interactions spread virally, external communities, including expert users, become engaged with the evolving product. Developers can capitalize on these emerging communities to facilitate further bricolage and encourage their contributions to product development. The findings highlight the significance of improvising spontaneous changes in the evolving product, such as adding new features, to specifically appeal to these emerging communities. These product improvisations catalyze resource contributions, such as valuable feedback, quality assistance services, and innovative feature suggestions. In the case of SK, the attention and involvement of the speedrunners' community, attracted by the project's backers, were leveraged to implement features that contributed to the game's innovative advancements. By combining these new resources with their existing expertise, developers can enhance team productivity and find inspiration to further enhance their products. This merging of resources enables developers to better navigate resource adversity, optimize their development efforts, and ultimately achieve successful product releases. In contrast, CL developers overlooked the opportunities to collaborate with backers in creating the product.

5.3.3. Exposing struggles and solutions

Stakeholders play a critical role in enabling development projects [38,51,72]. Likewise, crowdfunded developers communicate with backers as legitimate stakeholders [21,43,80]. Communication begins during the campaign and continues throughout the development process. When facing resource adversity, developers risk disrupting relationships with backers who identify with their projects [43]. Backers, for example, may react to delays by withdrawing support, depriving the project of necessary resources. This study suggests that crowdfunded developers can reduce backers' affective hostility and benefit from their resources by updating the campaign's communication style. They can shift from sharing *success* to *symbolic* stories that expose their struggles

and engage backers to brainstorm solutions. Although it is counterintuitive to invest limited resources in these efforts, communication aligns interpretations and helps negotiate expectations that restore backer willingness to contribute to overcoming adversity for mutual benefit [31]. The SK developers, for example, changed the focus on communicating success stories to openly discuss the need for a delay and engage backers in conversations to brainstorm solutions. This approach reduced backers' affective hostility and attracted their resources (e.g., feedback, contributions to game features) to overcome the adversity and progress toward the release. In contrast, CL's experience shifted from regular and enthusiastic fundraising updates to irregular and defensive communication, where backers were excluded from contributing opportunities.

6. Contributions to research and practice

6.1. Contributions to decision making for sustaining crowdfunded digital development projects

Crowd-enabled initiatives that aim to create digital products for crowds of people hold significant social and entrepreneurial potential [42,66]. They seek and combine resources from across the world, challenging the constraints of local resource scarcity in the globalized economy [63]. However, their outcomes are critical in shaping public opinion, as project success or failure can foster enthusiasm and support or lead to skepticism and discouragement [24,84]. Alas, the dominant focus on the fundraising of these initiatives offers an incomplete understanding of their performance [12,21,25,27,77].

Utilizing a longitudinal research design that explores crowdfunded developers' effective decision-making in tackling development challenges, this study establishes a grounded perspective highlighting the overlooked prevalence of resource adversity in crowdfunded digital development projects. The perspective explains why, despite receiving substantial support from a large crowd, these projects are susceptible to resource adversity and may lead to complicated outcomes. CL and SK, exceeding their campaign targets, faced challenges with limited resources, which aligns with recent discussions indicating that strategies leading to more funding can cause challenges [55]. The cases add to the conversation by elucidating two core reasons behind these challenges. Developers often set modest funding targets and pursue innovative ideas to attract a large crowd, facilitating successful fundraising but resulting in complex trajectories that manifest during development as the scarcity of critical resources like finances and human capital. Consequently, seemingly overfunded projects can still be underfunded, and the complexities of promised innovative products are revealed during feature development.

Moreover, the perspective highlights that resource adversity pressures developers to seek more funds or implement changes, such as reducing the scope of promises and deliverables, which can disappoint backers and lead to a loss of support [12,21]. This situation is also common in managing development environments under resource limitations while meeting stakeholder expectations [28,45,79]. Consistent with the research objective, this study highlights the critical role of decision-making in addressing resource-based challenges within crowdfunded digital development projects. More specifically, the perspective elaborates on crowdfunded developers' strategic decisions to navigate resource adversity while sidestepping complicated dynamics that may arise from potential changes to certain project aspects. Some of these decisions, such as considering stretch goals, staged delivery plans, and collaborative rewards, involve careful planning. Crowdfunded developers consider these decisions during fundraising to mitigate resource challenges during development, establishing a robust foundation for growth. Other decisions, like embracing radical entrepreneurship, transparently addressing challenges and solutions, and fostering innovation through improvisation and bricolage, emerge in response to resource adversity during development. These decisions expand developers' resource pool to navigate risky changes and ultimately deliver high-quality releases. These decision-making insights shift the literature away from dominant resource-based views that highlight the need for more resources. Instead, they underscore strategies during fundraising and development to prepare and practice resourcefulness [3,11,74,87,93].

Another key contribution is illuminating connections across the stages of pre-adversity, during adversity, and post-adversity, advancing our understanding of the largely overlooked but significant connections across fundraising, development, and post-release stages [21]. Through long-term decisions starting as early as fundraising, crowdfunded developers embody a mindset of "preventing or overcoming adversity" to one of "leveraging adversity for growth." This emphasis expands on research advocating for sustainable outcomes in crowd-based projects [21,24,26,82,84].

6.2. Contributions to organizational responses to adversity

The study's focus on crowdfunding for digital development has led to additional contributions.

First, the findings about strategic planning expand the existing literature on organizational decision-making in response to adverse events [70,85]. While existing research has focused on post-adversity decisions and restorations, this study aligns with organizational imprinting research, highlighting that newly founded organizations are influenced by their establishment environments [2,61,86]. Specifically, the study explores the pre-adversity stage by delving into the projects' fundraising, revealing early decisions that laid the foundation for the developers' subsequent experiences and responses to adversity. These insights highlight that *planning* is essential to establish a resourceful foundation to thrive amidst resource adversity. Notably, defining stretch goals for the post-release stage and collaborative reward structures enhances fundraising performance, fosters an external community as a buffer to minimize risky changes, and advances a long-term vision for growth after overcoming adversity. Such planning aligns with the concepts of proactive investment orientation [78,86] and effective risk mitigation [22,48]. In summary, the perspective offered in this study underscores the significance of foresight and visionary thinking, evident in developers' strategic decisions, as they enhance the likelihood of success in the face of resource challenges.

Second, the findings about developers' resilience to avoid risky changes build on research emphasizing persistence as an intentional and entrepreneurial process to overcome adversity [32]. Specifically, the findings highlight that persistence demands developers to embrace the idea that resources, such as their expertise and the support of the community, are not fixed but can be combined, repurposed, and deployed in novel ways to generate value [3,67,74]. In particular, these insights relate to community-based bricolage, which highlights the contribution of community members (e.g., backers) in combining and building on limited resources [95]. Beyond these existing insights, the findings about speedrunners reveal the significance of digital product improvisations that attract and engage community resources for subsequent bricolage activities. This insight is critical because past research often treats *improvisation* and *bricolage* as distinct activities [15,63,95]. In contrast, this study elucidates that developers' product improvisation, engagement with community resources, and the practice of bricolage can coalesce within an evolving digital product. In other words, community-based bricolage can manifest through interrelated activities that support and build on one another.

6.3. Practical implications

This study examines both successful and unsuccessful cases in the crowdfunding digital development industry, offering valuable insights for entrepreneurs and platform owners.

For developers, this study underscores the importance of strategic thinking when facing resource challenges at various project stages.

Collaborative rewards, for instance, boost fundraising and foster a supportive backer community, providing essential resources during development and beyond the formal release. This robust community foundation enables developers to improvise and attract additional resources, facilitating resourceful problem-solving and bricolage. Crowdfunded developers, often working under tight schedules and resource constraints, can leverage this blend of deliberate planning and agile adaptation to overcome resource challenges effectively and optimize project outcomes.

Furthermore, platform owners like Kickstarter seek to build credibility by providing valuable content to attract developers to their platforms. This study emphasizes the importance of offering tailored guidance for effectively managing resources throughout campaigns and subsequent development stages. Platform owners can enhance developer support by emphasizing strategic planning, fostering collaborative communities, and promoting improvisation and bricolage, all of which contribute to sustainable growth and success.

7. Conclusion

In today's competitive business landscape, where funding institutions and venture capitalists wield influence over markets [35], understanding how crowd-based platforms fund digital product development becomes crucial. Crowdfunding platforms play a critical role in fostering diversity and inclusivity in digital product innovation. This study elaborates on effective decision-making to help crowdfunded developers overcome some core challenges. This contribution supports digitally-enabled inclusive financing for digital development. As public trust in crowdfunding proposals grows, talented entrepreneurs are more likely to receive support, leading to diverse and innovative products. The limitations offer promising future research opportunities.

First, the intentional use of polar sampling uncovered the distinct intricacies of decision-making in crowdfunded digital development projects. By contrasting the experiences and decision-making processes of developers facing adversity, this study delved into the nuances of planning, improvisation, and bricolage in situations where differences were pronounced. This approach highlighted variations in developers' responses to challenges and their impact on project success. While these findings may not generalize to all crowdfunded projects, they reveal critical dynamics that can be further explored and expanded. Moving forward, researchers can employ quantitative methodologies to code the presence of challenges and application of strategies across larger samples, such as in projects with middle-range performance outcomes. Behavioral experiments involving participants, such as students engaged in projects, can enhance extant understanding of decision-making within crowdfunded digital development projects. Furthermore, researchers can interview crowdfunded developers to enrich the understanding of their experiences and decision-making.

Second, broadening the scope to include projects with diverse outcomes enriches extant understanding of decision-making dynamics. Though not the most recent, the empirical cases offer valuable insights into how crowdfunded developers address resource challenges, both in success and failure stories. As the crowdfunding landscape evolves, new stories will emerge, presenting opportunities for further exploration, especially into novel instances of resourcefulness.

Third, this study outlined strategies for crowdfunded developers to navigate resource challenges effectively. Projects may encounter resistance to change in various areas, influencing their development path and interactions with backers. Future research can build upon these findings by delving into nuanced aspects of resistance to change in response to adversity and adopting a holistic perspective considering fundraising, development, and post-release stages. Lastly, future research can expand on the outcomes of fostering communities around digital products, exploring potential adverse consequences on developers' performance and offering additional insights into community engagement dynamics and impacts.

Author statement

Shahla Ghobadi: Conceptualization, Investigation, Methodology, Validation, Formal analysis, Visualization, Data curation, Writing (Original Draft), Writing (Review & Editing), Project administration, Funding acquisition.

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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.

Data availability

The data that has been used is confidential.

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