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RESEARCH ARTICLE

Moral Hermeneutics in R&D Teams: Making Sense of Conflicting Responsibilities in Technological Innovation

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Abstract
This study adopts a hermeneutic, practice-based approach to Responsible Innovation to explore how a reflective and proactive attitude can be implemented in a start-up context. We hypothesised that a moral hermeneutics framework - rooted in post-phenomenology and theories on technology-induced value change - could provide a way to understand how practitioners in a start-up make sense of the different kinds of responsibilities in their work, balancing professional demands and standards of excellence with broader ecological and social commitments. Using in-depth interviews with the team members of a start-up R&D laboratory, we explored how they interpret their responsibilities-as-(moral)-obligations. Our findings suggest that the syntactical ways team members make sense of the relationship between these responsibilities can be useful for understanding how reflexivity can surface in this environment. We conclude by proposing that less conciliatory interpretations of conflicting responsibilities may lead to a collective search for practical solutions addressing these tensions, as long as it is embedded in a collective dialogue involving the other members' moral perspectives and technical expertise.

Keywords Responsible innovation · Moral hermeneutics · Start-up environment · Moral obligations in technology development

1 Introduction

During the past decade, Responsible Innovation (or RI) has been at the centre of a proliferation of philosophical lines of research involving numerous European and non-European academies and research institutes. The spectrum of these enquiries

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ranged from applied ethics (e.g., Grunwald, 2011; van den Hoven, 2014) to continental philosophy of technology (see Blok, 2018, 2020; or Blok & Lemmens, 2015). At the dawn of the new decade - while this paradigm, although no longer central to the European Commission's agenda, does not seem to have lost its prominence (van den Hoven, 2022) - Alberto Romele, Wessel Reijers, and Mark Coeckelbergh (2021: X) proposed a promising direction of investigation, which they named "Hermeneutic Responsible Innovation". This direction is in line with Armin Grunwald's insights on the need to consider the sense-making, expectations, and fears around emerging (sciences and) technologies that have a voice in debates on Responsible (Research and) Innovation and beyond (2014, 2016). This proposal was accompanied by a series of publications by the three authors exploring the narrative and symbolic dimensions concerning emerging technologies (Reijers, 2019; Reijers & Coeckelbergh, 2020; Romele, 2023).

In STEM start-ups, shared or individual narratives can orientate the conception and development of their technological product, as we will briefly discuss by referring to artificial intelligence (§ 2). Our proposal (§ 2.1) is that understanding how this sense-making activity interacts with the construction of values could provide an entry point for implementing responsible attitudes in a start-up's R&D laboratory, following a practice-based approach to RI. A similar approach, according to Russo-Spena and Mele (2016), views social reality as influenced and partially shaped by everyday activities rather than as external to individuals. More than just routines or processes, practices are embodied actions organised around shared meanings. In this context, the theoretical and methodological basis on which this empirical study is based is the 'moral hermeneutics' line of research developed by Olya Kudina (§ 3), of which we will examine the appropriateness and limitations for the analysis we propose. In § 3, we will also frame our analysis in terms of innovators' responsibilities as moral obligations, marking a difference with a value-based assessment of technologies from their effects on users. We will apply this theoretical framework in conducting a series of interviews conducted in the R&D division of a start-up that develops new technologies for the care of honeybees and biomonitoring through this insect (§ 4). In § 5, we will classify the interviewees' sense-making of the relationships between their conflicting responsibilities embedded in their work practice and in their technological product, some of them dictated by their profession and others by their desire to contribute to an external (ecological) goal. Finally, in § 6, we will expose the conclusions from the perspective of moral hermeneutics, suggesting new directions for investigation.

2 Narratives in Technological Start-Ups

The "organisational identity" and the mission and vision shared by start-up teams (Ala-Kortesmaa et al., 2022: 222, 223) in the form of "start-up community narratives" (Roundy, 2016) play a fundamental role in this type of enterprise. These narratives, constitutive of the company culture, often revolve around the technological product being developed and its potential, as the overlap of "product identity" and "company identity" is not uncommon (Ala-Kortesmaa et al., 2022: 235). In the

flexibility of the internal organisation and the unpredictability of a start-up's future developments, these narratives "play a key role in organisational reality, especially in *stability* and *change*" (Ala-Kortesmaa et al., 2022: 224; our italics) by sustaining the unity of the team through the difficulties occurring along the way. A relevant example of narratives' impact on both 'stability' and 'change' is the pioneering study on a dot-com start-up by Ellen O'Connor in 2002. From her analysis emerges the ability of internal storytelling, on the one hand, to unite a team (and investors) around an innovation idea and the values it embodies and, on the other, to change course while keeping the team intact following major adverse events, such as the crash of the dot-com bubble in 2001.

Nowadays, many start-ups are instead flourishing in an environment marked by the 'AI boom' (Brem et al., 2023; Tekic & Füller, 2023), which is characterised by the proliferation of imaginaries around the potential of this technology (Richter et al., 2023; Romele, 2023). As the proponents of a 'vision assessment' for Technological Assessment point out, these imaginaries have real repercussions on the development of any innovation (Grin, 2000; Ferrari et al., 2012; Grunwald, 2017), starting from its very name. As happened in the case of the "*Schreibklavier*=writing piano– *clavier imprimeur– cembalo scrivano*" for the writing machine (Mambrey & Tepper, 2000), this also applies to the metaphor contained in the 'artificial intelligence' binomial itself (Carbonell et al., 2016). Since the beginning, in fact, these couple of terms created expectations and prioritised research directions also due to funding to which they gave access (Floridi & Nobre, 2024). More radically, some technological imaginaries related to artificial intelligence describe its (future) powers in terms of "Singularity" (Chalmers, 2010) or "Superintelligence" (Bostrom, 2017). In turn, these imaginaries derive from what Dreyfus (2012) calls a "first-step fallacy", cyclically present in the evolution of AI over the last decades, which is a narrative promising a progressive, if not exponential, development from an initial success. Similar narratives may also shape the future impact of AI on innovation management (Füller et al., 2022; Brem et al., 2023), product innovation (Cooper, 2024), and corporate innovation (Bahoo et al., 2023) in the various sectors and organisations, including start-ups.

In all these areas, the idea of "repairing how we think about AI" has been invoked to highlight its environmental impacts beyond an image of immateriality (Stone & van Wynsberghe, 2024; Baum & Owe, 2023), the biases hidden by an idea of impartiality (Buccella, 2023; Ferrara, 2023), the human moral responsibilities beyond apparent machines' intentionality (Redaelli, 2024), and the absence of human-like intelligence (Floridi, 2023: 12) despite the terminology borrowed from Cognitive Sciences (Floridi & Nobre, 2024). Coeckelbergh (2023) even suggests recognising a "narrative responsibility" requiring us to make sense of this new technology in accordance with our life and our society, an expression of which we can find in Human-Centred AI. This article also intends to bring together the moral and narrative dimensions, yet without focusing on either AI or the imaginaries evoked by another technology. Instead, its emphasis will be on how values and responsibilities unfold in a start-up members' meaning-making of the reasons for existence, the direction of action, and the possible developments of the technology they produce.

2.1 RI in Start-Ups and Hypothesis

Following up on a 2023 article dedicated to the search for a model for social responsibility in start-ups (Ryan et al., 2023, 2024) offers a different perspective on the problematic application of RI models or measurements in this context. According to their first paper, the literature on the topic proves unsuitable for addressing the "intricate and idiosyncratic nature of a start-up" in its differences from other organisational formats. Therefore, Ryan et al. (2024) highlights five characteristics that illustrate this difference, namely the plurality of roles of the different members, start-ups' specialisation in their products, the limited control over the success of their product, the lack of stakeholders (if not prospective ones), and, in the case of STEM start-ups, the dependence on a core of "highly skilled employees" to conduct R&D activity. Building on these analyses, Ryan et al. (2024) notes the limitations in measuring social responsibility in start-ups "solely in numbers or metrics". Instead, the authors propose "prescriptive indicators" that keep track of the positive actions companies should perform to demonstrate their social or environmental engagement with investors, such as establishing core values and providing employees with "socio-ethical training" (point 17). These practices are ways for start-ups to "engage with and reflect upon social responsibility", thus making its members adopt a perspective going beyond their role responsibilities or the start-up's imperative of efficiency and profitability. This proposal may extend the "practice-based" approach formulated by Boenink and Kudina (2020), which conceives values as embedded in (and influenced by) the practices surrounding innovation once it has been introduced in society, to develop a framework taking into account the (practical and hermeneutic) activities of a start-up team that could shape the development of a technology still not implemented in society.

In this article, we hypothesise that this engagement and reflexivity, oriented towards the responsibility to be assumed in the development of technological innovation, can find a grounding in the internal narratives that define the identity of a start-up and its team's shared mission and vision. We thus intend to continue the approach already taken by Ustek-Spilda et al. (2019) in describing, based on MacIntyre's concepts, the dimension of the "social imaginaries of technology development" in IoT start-ups and the way they shape the identification and assumption of their responsibilities as innovators. Their study led to the classification of three action positions among the team members, described as "disengaged", "pragmatist", and "idealist", and the description of their attitudes towards these issues. In addition to this paper, the approach of Hankins (2020) is relevant as well, as he analyses how an adequate shared narrative can contribute to Responsible Innovation in a company or research laboratory. However, we will base our analysis on a distinct theoretical and methodological background.

3 Moral Hermeneutics and Moral Obligations

In investigating the hypothesis formulated above, we will follow the 'moral hermeneutics' line of research as developed in recent years by Kudina (2019, 2023), which accounts for both the "projective and practical dimensions" of making sense of a new technology and for their impact on the individual's set of values (2021). Kudina (2023) argues that this direction of enquiry adapts Peter-Paul Verbeek's (2011) theories of "technological mediation", whereby technologies mediate moral perceptions and actions, to the idea of value dynamism and value change promoted by van de Poel (2021, 2022). In particular, moral hermeneutics foregrounds how these changes and dynamism in values can derive from their *interpretation* "in relation to specific technologies" (Kudina, 2023: 4). This path of enquiry also requires considering values not as a mere "consequence of technological mediation", as in Verbeek's post-phenomenological account, but rather as a "moral infrastructure" that sustains the hermeneutic human-technology-world relationship and is continuously reconfigured by it (2023: 19, 32). She then depicts this reconfiguration of values as a 'lemniscate', in which the 'Technology' factor is added to the Gadamerian 'hermeneutic circle'. This scheme highlights the bi-directionality, seamlessness, and continuous nature of the process of "projective appropriation" of a technological phenomenon, throughout which the existing framework of understanding is necessarily modified (2023: 52). This is also stated by van de Poel and Kudina (2022), where the authors describe the "value change" induced in users by the indeterminate situations resulting from the (possible) introduction of a new technology in society. Instead of a change in values, however, our analysis will focus on the possibility that a conflict among values on the developers' side may result in questioning and adjusting some aspects of the technological product. Through empirical analysis, we will try to understand how this process could be influenced by the role played by values in practitioners' sense-making of their work and responsibilities.

Nevertheless, we also observe some limitations in applying moral hermeneutics to the research, development, and production of technological innovation since, to date, this line of research has focused on the sense-making related to the (prospective) usage. To be sure, we are not asking here how to foresee the discomfort eventually felt by the future *user* and *non-user*, namely the tension between "immediate value" and "generalised value" that van de Poel and Kudina (2022), quoting Dewey, see as the source of value change. Instead, we are referring to the possible doubts of the engineers or other enterprise members about how to make sense of the conflicting goals (and conceptions of 'good') they endorse in the R&D phase of an emerging technology. More precisely, rather than on values as such, we will focus on responsibilities, specifically on what van de Poel (2015) labels "responsibility-as-(moral)-obligation". This allows abstract values to be substituted with the obligation to secure the interests of precise stakeholders, be they customers, animals, colleagues, or others. According to van de Poel, this is a forward-looking responsibility that corresponds to the "obligation to see to it that something is the case". Taking the well-known parable by H.L.A. Hart (reformulated, among others, by Vincent, 2010) about the different meanings of the term 'responsibility', it corresponds to the responsibility of 'Captain Smith' for ensuring the safety of the crew and of the passengers.

What Vincent calls "role responsibilities", however, are distinguished by van de Poel into "responsibilities-as-task" and "responsibilities-as-(moral)-obligations". There are role-related tasks that do not align with what we should do (from a moral perspective) having that role, and there are role-related moral responsibilities that do not correspond to any 'task' assigned to us (we will see in the next paragraph what 'role-*related*' means). Arguably, this friction between role responsibilities and responsibilities as *moral* obligations in this role is indispensable for a reflective team. In what occasion or context may team members' role responsibilities (both normative and descriptive ones) appear to be inadequate in defining their moral responsibilities? Or, most importantly, how can an eventual tension between role and social or ecological responsibilities emerge in team members' interpretation of their position in the process and of their start-up in society? That would require either a new narrative account of the technology or, ideally, finding a technical solution to the conflicting responsibilities. We will attempt to answer these questions and fill this gap in moral hermeneutics by conducting empirical research in the R&D division of a start-up developing new technologies with a strong ecological drive. This empirical approach, consistent with the turn in the philosophy of technology proposed by Achterhuis (2001), is described by Kudina (2019, 2023) as an indispensable direction both for better understanding the emergence of moral tensions and value change and for applying the insights formulated by moral hermeneutics into the real world.

Before proceeding, we should say a few words about the necessary conditions for responsibility-as-(moral)-obligation, so as to understand the practical dimension in which it can be articulated, far from abstract aspirations. As stated by van de Poel (2015) referring to responsibility-as-(moral)-obligation, "[a]ny reasonable theory or principle for distributing responsibility should at least meet a minimal condition with respect to causal efficacy". He then articulates this causality condition, applicable across deontological, consequentialist, and virtue ethics perspectives, as follows: "*if i properly fulfils her supervisory duties to see to it that φ under normal circumstances*, *φ will occur*". While I broadly agree with this definition, I propose an alternative that does not so rigidly define the practical feasibility of implementation. Instead, I argue for the importance of considering the broader goals to which an individual can, at best, aspire to contribute. Without this broader perspective, there is a risk that the assumption of responsibility for sustainable and socially desirable innovation becomes appropriate (or 'reasonable') only in narrowly defined cases, since the causal link in the realm of technologies is rarely straightforward (see, for example, Swierstra & te Molder, 2012). Therefore, I propose to define this causality condition by the fact that '*i* is in a position of power whereby if *i* properly fulfils her supervisory duties to see to it that *φ*, it is reasonable to assume that this contributes to the occurrence of *φ*'. Defining this condition allows us to highlight which of these responsibilities are reasonable, identifying them with those in which *i* plays a role that allows her to act in a manner relevant to the occurrence of *φ*. Since the continuous development of a technology may change how its developers interpret the actual potentials related to it, and with them their own role in pursuing or preventing possible consequences, we can identify a circular hermeneutic process here as well. It does not follow, however, that this necessary condition is also sufficient, and that claiming to have a role is tantamount to recognising the corresponding responsibility-as-(moral)-obligation.

4 Methodology

Following Kudina (2019, 2023), this research adopts the Interpretative Phenomenological Analysis (IPA) methodology, developed by the psychologist Jonathan Smith in the late 1990s. IPA is a qualitative, essentially idiographic approach to research in psychology, which nonetheless can offer significant insights into how individuals or groups make sense of their experiences, such as their actions and responsibilities in the construction of technology. IPA is considered a hermeneutic process because it recognises the impossibility of directly accessing people's experiences. This hermeneutic approach, known as a "double hermeneutic", requires the IPA researcher to interpret the perspectives of the interviewees as they, in turn, seek to understand and articulate their own experiences (Smith & Osborn, 2003). IPA involves a thorough, in-depth examination of the participants' experiential narratives, leading to "patterns of convergence and divergence across the research cases". To comply with this type of analysis, this method requires conducting semi-structured interviews on a small number of cases (Smith et al., 2008: 56, 57). It privileges deepening and interpreting a limited number of experiences over quantitatively sound, objective results. "This subjectivity is a systematic product of the dialogue between the different levels of interpretation and is open for the reader to verify through both the researcher's analysis and excerpts of the participants' interviews" (Kudina, 2023: 77, 78). In any case, these excerpts are never considered per se but always as part of an emerging pattern from the interviews, extracted through an intensive reiteration of the transcript reading. That makes this method a powerful "hermeneutic tool to explore the sense-making activity of people based on their historical and social situatedness" (2023: 78).

We conducted the interviews over two days in July 2024 within a start-up's research and development division (ten people in total). To provide some quick context, the technology around which this R&D team interacts broadly consists of a hive base equipped with tools to monitor the health of the honeybee colony, protect them against threats (such as a treatment against the *Varroa Destructor*), and use the *Apis mellifera* to bio-monitor the health and biodiversity of the surrounding environment, for instance, by detecting the quantity and colours of the pollen brought into the hive. The team comprises a beekeeper, two designers, two software developers, one AI researcher, two experts in electronics (including an intern), a country manager, and an experienced business manager. The conversations took place in French, but we will provide translated excerpts in English. The length of the interviews ranged from one hour and fifteen minutes to thirty-five minutes, with this variability primarily due to two members being hired just weeks before the interview. Following these meetings, we transcribed the content of the recorded audio and proceeded to its coding and analysis after three re-readings of the transcripts. The extracts' selection and classification highlighted the possibility of quoting the interviewees without referring to the specific interlocutors, even anonymised. We, therefore, preferred to report in this form the most relevant quotations as exemplary elements of the categories that emerged in the codification phase.

Before proceeding with the analysis of the results, we would like to further emphasise the idiographic nature of the IPA methodology. This means that it examines the specific case, in contrast to the predominantly 'nomothetic' approach in psychol-

ogy, which generalises findings to groups or populations and seeks universal laws of behaviour. Idiographic methods involve a systematic study of small, purposefully selected samples and can include single-case analyses (Smith et al., 2008: 29). For this reason, we do not claim that the case we have selected can be generalised in the form of a behavioural law. We recognise, instead, that this is a specific case where the contrast among moral obligations is made acute by the very nature of the developed technology, which has to weigh the interests of human and non-human stakeholders.

5 Results

In the following pages, we present the results of our interviews by organising them around two thematic areas that emerged as central to the sense-making of the start-up members. As outlined in the methodology, this (moral) hermeneutic process includes various dimensions, from the motivations that led each individual to join the company to their expectations regarding the future development of both the technology and its applications, as well as the start-up's overall evolution. These themes provide insights into how team members understand their roles and responsibilities within the organisation and the broader societal context. A central part of my analysis focuses on the relationship between the role-based responsibilities within the productive horizon and the socio-ecological responsibilities that team members recognise and adopt. These responsibilities encompass a range of moral obligations, reflecting personal values and professional duties. At times, socio-ecological moral obligations conflict with the specific responsibilities, including those understood as 'morally sound', associated with their roles as engineers, designers, or other professionals in the start-up. To explore the nature of these tensions, we turn to Alasdair MacIntyre's concept of practice, which provides a framework for distinguishing between different types of goods and responsibilities. The internal goods of a practice are those achieved through efforts to 'see to it that' the "standards of excellence" defined by the relevant community are upheld (MacIntyre, 2007: 187). By using the formula 'see to it that', I aim to translate into this notion the responsibilities-as-moral-obligations associated with playing (and assuming) a given role, also to avoid the narrowness and specificity of the concept of practice. For example, in the engineering field, internal goods include the pursuit of technical expertise, innovation, and efficiency, aligning with professional standards. These internal goods differ from external goods, including financial profit, career advancement, and societal or ecological benefits arising from their work. Recognising this distinction helps clarify how start-up members balance their professional commitments with broader ethical responsibilities. These external goods may also relate to other practices and roles, such as supporting a family or contributing to the well-being of the ecosystem.

In this section, we will analyse how the start-up members took into account, in answering my questions, both the internal goods and standards of their profession (i.e., the will to advance in their profession) and enterprise and the external goods and social or environmental responsibilities that might be pursued through them. Instead of dividing this section according to this dichotomy, we will observe the relevance of both these perspectives in the motivations that the team members presented for

their joining the start-up (§ 5.1) and in the choices they make or made (individually or as a team) throughout the development of the technological product as well as in the expectations they have about the start-up and the technology to come (§ 5.2). In all these cases, we will also underline the different ways in which they interpret the relationship between these two goals, which will be further explored in the following discussion of the results.

5.1 Practical and Socio-Ecological Motivations

When asked to explain their reasons for founding or joining the start-up, all team members presented different motivations that can easily be linked either to a passion for their work or a desire to create a positive product for society or the environment. Our interviews revealed how a significant number of team members were motivated by the start-up's focus on creating a positive impact on both the local and global levels. They saw their enterprise as more than just a business venture but as a movement that could inspire broader societal changes, funnelling ecological values. At the same time, the technology they contribute to developing was not merely viewed as a product but as a vehicle for change in the relationship between humans and the environment on various levels. How this ecological and social aspect is conceptualised within their motivations varies from individual to individual, reflecting their different sensitivities. This range goes from the desire to "save the bees" as such, supporting small beekeepers in facing threats like climate change, new diseases, or parasites that endanger colonies and threaten their survival, to considering the honeybee colony not only as a pollinator but also "as a monitoring agent of the planet's ecosystem", with a focus on global environmental challenges. On a more personal level, their joining the team could also derive from their desire to reconnect individually with nature (e.g., "my first motivation was to get closer to nature"), giving ethical value to "working with living beings and bees". This motivation also includes a wish to "discover how [honeybees] work and the intelligence of these tiny insects", as expressed by most team members. Another common theme among the interviewees was the search for a sense of purpose and meaningful work. Many had previously worked in industries they felt lacked this dimension, and they sought to realign their professional lives with more ethical and environmentally conscious values, using (and growing) their professional skills for a cause they genuinely believed in. One member described this as a "quest for meaning… as we get older, we also seek a little bit more to give meaning to what we do, and give meaning to what we do every day".

Let us now turn to the motivations linked to one's dedication to his or her work practice and the belief that it can best be cultivated and exercised within the start-up context. These motivations vary, of course, depending on each member's specific role. In addition to this, we found a variety of ways in which these aspects are articulated. Four of them emphasised their desire to give themselves new stimulating challenges to tackle through their expertise since the development of this technology constituted "a new challenge, full of things that I did not know at the time". Another point mentioned was the exploratory nature of the product, which opened up numerous directions without a predefined roadmap, creating "possibilities that you don't find in other fields". The idea of putting into practice what they "learned

in school and making it tangible" was expressed by a younger member, while a more experienced one saw the start-up as a space where they could "be heard" of their own opinion, stating that "that's what a start-up is a bit like, everyone exchanges ideas; everyone builds something together". A senior member viewed it as the chance to "finally return to something I've always wanted to do but never had the opportunity for", finding in it the possibility to "get back into it, see how everything has evolved, and also catch up". Finally, proceeding among the most experienced members, one of them saw in the start-up model a significant autonomy in the success of their product, created from scratch, expressing the desire to be responsible for their own success. Across different age levels, a shared sentiment among all members was the positive view of the multitasking required in a start-up environment, where the small team size demands that each person take on diverse tasks that would be handled by dedicated departments in a larger company. As one member expressed, echoed by others, working in a start-up provided the opportunity to "work on different domains", which was seen as an advantage.

Regarding the balance between these two types of motivations, the emphasis on one over the other varied by individual. The team was split between those who prioritised creating something beneficial for the environment and honeybees and those who saw this aim as secondary (though never irrelevant), at least in the context of their initial motivations. Although a group this small does not warrant proper statistical analysis, it is noteworthy that this distribution did not result in a stark division. Indeed, it was rare for someone to present these two reasons as juxtaposed with an evident preference for one over the other. For example, the following quotation clearly expresses the greater importance of the search for meaning in one's work than the desire to pursue standards of excellence in their profession: "I loved what I was doing [before joining the start-up], but I didn't find as much meaning in it. So, the result often, I say, it's not the most important thing. What's important is the process, the doing, and that's what I loved most. I loved the teams, I loved the projects. It was great. But in the end, the result didn't excite me that much". On the other hand, one member interpreted the ecological aspect as a "bonus" or a "plus" because their initial interests were mainly in nourishing and putting into practice their expertise, "although applying it to something that has a bit of that bonus is great". Apart from these two examples, in the context of initial motivations, these two aspects are primarily articulated in parallel, whereas in the next section, we will see a greater variety in the links between practice-driven (or efficiency-driven) reasons and ecological intentions in the context of individuals' everyday actions and future expectations.

5.2 Efficiency and Social Responsibilities in Action

The dual nature of the members' intentions is visible not only in their initial motivations but remains constant in the meaning they give to their work, the team, and the technological product when interrogated about the role of ecology in their everyday routine or their expectations about the future of the start-up. Whereas in the previous section emerged a significant variety among the team members' motivations both as practitioners and individuals, in this one, the focus will be on the different relationships ascribed to these two sides of their identity (and the startup's). Despite these dif-

ferences, everyone agrees that these ecological aspirations must be measured against the practical needs of the start-up and its product, which require certain standards of efficiency and profitability. At the same time, they agree on the need to maintain an ecological direction. In particular, this goal is interpreted by many as a fundamental element ("the basis of the company's creation is preservation, ecology, ethics, and all that") - whether it is seen as a duty to be monitored ("these questions must be asked and answered"), or as a connection that will necessarily survive the time ("there is necessarily this link, and this link is indeed in line with the very existence of [the start-up]. So, it means that there is the capacity to touch, to touch the heart, let's say, of everyone working for [the start-up], whether they are two or three people or 1,000, 10,000 people one day").

That said, we have identified different ways start-up members made sense of the relationship between these two aspects. Due to the hermeneutic approach we adopted in our research, we have coded them according to the types of coordinating or subordinating conjunctions that can best translate these relations. Indeed, we believe that they can thus illustrate more distinctly the hermeneutic operation of the start-up members with respect to the connection between the different sets of values and responsibilities guiding their development of a new technology. Table 1 shows the various types of conjunctions that we found relevant, and we will see a schematic example of each. Here, we will use the variables 'aR1' and 'aR2' for 'action(s) required by responsibility 1' (and 2), where R1 refers to the responsibilities dictated by the embeddedness of the start-up and the individual's work in a productive context, and R2 refers to the commitment, felt by the individual and expressed by the company, to pursue common, socio-environmental goods. In other words, 'aR' denotes the action that satisfies a specific responsibility-as-moral-obligation. Here, 'satisfies' indicates that, by undertaking these actions, we actively perform our "(self-)supervisory duties to see to it that" something (φ) is the case, without implying that these actions will necessarily cause φ to occur (cf. van de Poel, 2015). On the rightmost column, we will report a significant quotation excerpted from the interviews. The classification of the quotations according to these parameters is neither meant to be exhaustive nor rigid, as there is the possibility that some quotations could be translated into different formulations. Instead, the most relevant aspect is to highlight the multiplicity of syntactic categories that may come into play in elaborating on the moral significance of a new technology, and its significance will be discussed in the next section.

6 Concluding Discussion

In the previous paragraphs, we attempted to capture the different responsibilities-as-moral-obligations embedded in practices around technology (§ 5.1) and how they interact with each other in team members' sense-making (§ 5.2). From our interviews, it became clear that these responsibilities interact in various ways, as reflected in the interpretations of different team members about their own and others' involvement in developing their technological product. The individual moral hermeneutic approach can manifest in diverse forms, as we illustrated with different rhetorical styles in Table 1. Certain couplings seem conciliatory, aligning conflicting responsibilities (R1

Table 1 Different ways in which the start-up team members conceived the relationship between role and ecological responsibilities (and required actions)

Conjunction type	Example of aR1 and aR2 relationship	Exemplar quotation
Additive: Role-related responsibilities and ecological commitments are seen as equally important.	We (want to) perform aR1 'and' aR2 - while the contrast between the two is not explicit.	"to make it both a message of, how to say, safeguarding the planet, but also (*mais à la fois*) to give economic viability to [name of the start-up] as well, since every company needs that".
Temporal: Ecological considerations are addressed during specific stages of the work process.	We perform aR1 'before' aR2.	"We're not going to shy away from carrying out heating tests several times a day to test our system […], because that's the priority, we need our system to work so that we can help as many [honeybees] as possible. One has to know how to spend in order to be able to save later".
	We perform aR1 'while' being attentive to aR2. But also: We perform aR2 'whenever' it is consistent with aR1.	"…what is known as eco-design, which is the use of techniques that enable us to use less energy, or to avoid printing or things like that. Personally, […] I try to take an approach like that whenever I can".
Comparative: Greater focus on one responsibility enhances the ability to fulfil the other.	"The more" we perform aR1 "the more" we perform aR2.	Concerning research and tests on honeybees: "the more we know about things, the easier it is to help […] nature". About the software architecture: "the two go together: the more economical it is, the more ecological it is".
Conditional: Professional goals are pursued only if compatible with ecological obligations.	We perform aR1 'provided that' we do our best for aR2.	"It's an intrinsic part of our mission. It's about having the least ecological impact, okay? The least possible impact… of negative impact, of course… the least negative impact".
Concessive: Ecological responsibilities take precedence, but professional goals remain significant.	We perform aR2 'although' it is detrimental to aR1. E.g., through a compromise.	"Well, maybe solar panels would be a hell smarter, a hell more ethical. A hell more… Perhaps it won't work as much effectively. But in the end, it's still, it's still a hell of a lot nicer than a big block with a generator engine".
Adversative: Role responsibilities sometimes conflict with ecological goals but are pursued concurrently.	We want to perform aR2, 'but' it is difficult to make it consistent with aR1.	"we have to use products that have the least impact on the environment, but at the same time, we need very solid, very durable products, because […] a beehive is outside all year round […]. And it all has to be strong. You see? So it's very, very complicated. It's very complicated to do both, to combine the two. It's really two extremes in fact".

and R2) through additive or temporal conjunctions, where no clear tension arises between the actions required by professional and ecological obligations. A 'comparative' approach may even highlight a positive, ideal synergy between these responsibilities, particularly in cases where greater attention to aR1 enhances the ability to address aR2. In contrast, other styles, characterised by conditional, concessive, or adversative conjunctions, emphasise the tensions between these responsibilities. Among these, adversative conjunctions express an unsolved tension, enabling what MacIntyre (1999) describes as "question[ing] the hitherto unquestioned", or critically examining the relationship between efficiency and social responsibilities while pursuing a "quest for *the* good" by 'ordering' these different goods (see MacIntyre, 2007: 219).

According to MacIntyre, the abovementioned 'questioning' arises only when a conflict between these responsibilities becomes apparent. Two plausible directions emerge from this tension: reconciliation through a new narrative making sense of these divergences or seeking a technological solution that fulfils both responsibilities within the practice itself. We consider the latter approach the most valuable in addressing moral dilemmas involving conflicting responsibilities and in benefiting from the heuristic potential these dilemmas disclose (cf. van den Hoven et al., 2012). Indeed, in an R&D context, *practically* reflecting on these unconciliated moral obligations *might be* the starting point for the team's search for technological possibilities that could harmonise excellence standards with socio-ecological responsibilities. As we mentioned above, 'fulfilling' these responsibilities means exercising one's '(self-) supervisory duties to see to it that something is the case', integrating these duties into the development of the technology, without resorting to "satisficing" compromises that do not fulfil these moral obligations (cf. Wallace, 2019: 27 to see the contrast between the latter two notions). In saying this, we do not mean to exclude that there may be moral dilemmas that cannot be solved by technological changes, even as a long-term 'moonshot'. Apart from the fact that some responsibilities may have to be questioned on a theoretical level, we simply intend to suggest a direction to investigate how to fulfil the different goods being pursued in technological development.

Following again the argument in Boenink and Kudina (2020), interpreting values as fixed entities, as seen in both 'substantive' and 'procedural' approaches, unnecessarily narrows the options for addressing value conflicts. In the entity-based approach, resolving such conflicts often reduces to either prioritising one value over another (such as placing safety above privacy) or "balancing them" (sacrificing some privacy to increase safety). Instead, considering values as living experiences embedded in practices allows for "more creative ways to address ethically challenging situations". However, while they suggest seeking solutions to moral conflicts by reinterpreting values in response to a specific situation, we propose a different approach. Since it seems to us that this reinterpretation of values may lead to arbitrary and self-interested decisions in a business environment, we would rather foster a reinterpretation *of the technology*. In other words, understanding the embeddedness of values in the technological objects enables practitioners to ask themselves whether their product (or a specific feature in it), while supporting their adherence to the values of their practice, can, *at the same time*, fulfil their social and environmental responsibilities. Let us give a simple example. As the interviews revealed, many of them acknowledge the importance of wild bees for the ecosystem, but strengthening the presence and resistance of the domestic honeybee can be an obstacle to their survival. Yet, their mission includes developing new technologies to make honeybees more resistant and resilient, and they have to promote the diffusion of beehives in agriculture and forestry. In addition to limiting the number of honeybee colonies in an area (balancing responsibilities through compromises), it might be useful to consider how the technologies that are installed around beehives can also help wild bees to proliferate in the same territory. Actually, biomonitoring is also already understood in this key in the team's internal discussions and communication material. Naturally, after this, it will be necessary to make this new ideal functionality a reality by implementing it in the technology or its distribution.

Drawing from the post-phenomenological tradition, Ihde's concept of "multistability" may become particularly relevant here. This idea captures a key characteristic of technologies: they can support multiple purposes ("multi") while being restricted to a finite range of possibilities ("stability"); for example, a table can serve various functions but cannot be used for everything (de Boer, 2023). The underlying insight is that "at the complex level of a cultural hermeneutics, technologies may be variantly embedded; the 'same' technology in another cultural context becomes quite a 'different' technology" (Ihde, 1990: 144). In our case, this notion can provide a hermeneutic framework to reimagine the uses and potentials of a technology from the perspective of different roles assumed by practitioners (and the corresponding responsibilities). Alberto Romele argues that this hermeneutic approach overlooks the tangible impact of culture and society on the processes of *inventing* and *implementing* specific technologies (2023: 95). However, we do not share this critique, as Ihde explicitly addresses how varying cultural interpretations of the same technology result in significant differences in its implementation and development. While sardine cans (Ihde's well-known example) may not transform into new technologies, "gunpowder and rocketry for celebration [in China] contrast with the same materials fitted into siege and warfare [in Europe]" (Ihde, 1990: 128). On the other hand, a criticism that can be raised is that the overlapping of different identities (or 'roles') in the same individual and functions in the same artefacts is left unthematised. Indeed, even in the example of gunpowder, the result is a bifurcation of the evolution of technology, rather than an overlap of functions. This conflicts with our finding, since, as we have seen above, an engineer may play several roles, each of them addressing a different good, according to which she interprets the potentialities of the under-development technology in various ways (without necessarily imagining diversified directions of development). The tension between these goods may thus be resolved by leading the evolution of a technology to practically reconcile the various responsibilities that, in the eyes of innovators, its development might pursue. In other words, the conflicts may be settled by pursuing '*the* good' as a technological innovation (and the world unfolded by it) that gathers and orders the fulfilment of different responsibilities-as-moral-obligations. Indeed, the overlap of two uses and functions, such as employing biomonitoring for both its original purpose and for the benefit of wild bees, enables the simultaneous pursuit of two distinct goals.

The search for an ultimate good is, for MacIntyre (2007: 219), a "narrative quest", in which an "intelligible narrative" is sought that gives unity to the individual's existence through all her roles (2007: 225), thus seeking a unitary goal that allows us to find "integrity and constancy in life". From an ontological perspective, this 'good' does not stand to the other goods in a universal-particular relation (as already rejected by Aristotle, NE I,6) but is a teleological narrative that brings together and relates the different goods considered relevant in a given context. According to him, this 'quest' "is not at all that of a search for something already adequately characterised, as miners search for gold or geologists for oil", but proceeds by trial and error, in a progressive knowledge of the self and "of the character of that which is sought" (2007: 219). As we mentioned above, our proposal is that one can locate this search for meaning directly in the development and implementation of a technological artefact that gives voice (and order) to the different moral obligations of individuals and teams. This

can build on what was said in § 2 about the value of narrative in a start-up, on the aspirations of individuals seen in empirical research, and on the widespread desire among individuals to create their own product ("*un produit à nous*"). Here, then, the hermeneutic approach to innovation can understand the technological artefact not only as a mere object of signification but also 'as' a form of narrative, i.e. 'as' a creation of sense that catalyses different aspirations and makes them unfold in the new ontological order opened up by an innovation (see Blok, 2021). However, despite expressing the moral responsibilities that team members intend to fulfil, this does not mean that they are in control of them, not only because of the technical limits imposed by material reality but, above all, because of the impossibility of mastering the ontological world that this establishes, and which may not see the various goods pursued being realised.

It remains to be seen whether (and how) artificial intelligence can play a positive role in linking the fulfilment of one moral obligation to another (translating data obtained in one process into information relevant to another), or whether, on the contrary, it hinders this process by maximising effectiveness within specific horizons of meaning (following the corresponding 'standards of excellence'). Further research is also needed to understand how to make the individual moral conflict consequential by placing it at the centre of a practical reflection shared by the team that is envisioning, designing, and developing a new technology. For this heuristic purpose, in fact, various start-up members emphasised how this internal discussion among different perspectives and competencies proves to be fundamental. Similarly, several interviewees pointed out that this interaction with others is a necessary step to continuously uncover critical aspects of the technology under development, maintaining an attentive attitude in the team. In the words of one member, for example, we see both these aspects in sequence: "Sometimes someone has an idea, they present it, and then everyone joins in, even while working, turning to the discussion. That's the kind of dynamic I really like because we're a team, working side by side, and communication is very fluid at this level. […] Yes, we are eating and then: 'But what do you think about generators in nature?' And then you realize that people generally agree it's not ideal".

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Data Availability In order to respect the data anonymity also among colleagues, it has been preferred not to share data in a public repository.

Declarations

Ethics Approval and Consent to Participate This study did not require ethical approval. The interviewees provided their (written) informed consent for participating to this study.

Consent for Publication The respondents gave their (written) informed consent for publishing this study including their anonymised interviews.

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