How Organizations Constitute Technological Visions to Navigate Uncertain Futures

Elie Saaoud
HEC Montréal

Romain Rampa
Institut Polytechnique de Paris

Marine Agogué
HEC Montréal

Corresponding author
Elie Saaoud
Department of Management, HEC Montréal
3000 Côte-Sainte-Catherine Road
Montréal, Québec (Canada), H3T 2A7
elie.saaoud@hec.ca

Submitted: June 30, 2022
Accepted: January 11, 2024

Abstract
Emerging technologies are characterized by malleability and incompleteness, rendering them profoundly unpredictable. Science and Technology Studies (STS) have underscored the significance of prospective narratives, such as technological visions, in managing the inherent uncertainty of emerging technologies. However, the dynamics of prospective narratives within the settings of organizations remain underexplored in organizational studies (OS). Therefore, this paper explores the mechanism by which organizations frame emerging technologies and navigate the future's intrinsic uncertainty. We investigate these issues through an ethnographic case study of EnerCo, a large electricity utility. We find that the process of constitution of a technological vision is driven by iterative enactments of anticipating, which involves creatively formulating prospective narratives, and disseminating, which encompasses transferring and translating prospective narratives into new social settings. By bridging the STS literature on technological expectation and the OS practice framework of zoom in/out, we offer a fresh outlook on the reciprocal relationship between organizational dynamics and technoscientific narratives.

Keywords
emerging technology; technological vision; sociology of technological expectations; practice theory; ethnography; organization studies; science and technology studies.

1. Introduction

Technological innovation is more than ever erected as a main vector of growth and competitive advantage for organizations. To ensure their relevance, organizations are expected to proactively detect, develop, and integrate emerging technologies. Staying legitimate or falling behind is largely conditional on the (in)capacity of organizations to anticipate, grasp and exploit technological changes (Day and Schoemaker 2000). However, the nature of emerging technologies is characterized by malleability and incompleteness, making them highly uncertain and unpredictable (Bailey et al. 2022).

Despite this ambiguity, organizations must take present action towards future-situated technologies to mitigate risks and capitalize on potential opportunities. This problem rais-

es the need for organizational mechanisms that help make emerging technologies more predictable and actionable entities (Alvial-Palavicino 2016). In this context, this paper draws connections between organizational studies (OS) and science and technology studies (STS) to explore the practices and processes that enable an organization to frame and act towards future-situated emerging technologies.

The STS literature has highlighted the role of prospective narratives, such as technological visions, in rendering technological futures less ambiguous and guiding innovation trajectories for technoscientific fields (Borup et al. 2006). Such narratives set expectations about future technological developments shaping acceptable actions and influencing the innovation practices of actors who participate in their production, dissemination, and consumption. However, this literature has largely overlooked the dynamics of prospective narratives within organizations. This is surprising considering that organizations serve as pivotal sites for technoscientific development, and their legitimacy and resilience depend on their capacity to integrate such innovations. Therefore, this paper is guided by the following research question: How do organizations formulate a coherent understanding of their technological futures?

We conducted a two-year ethnography of the constitution of a technological vision in the research center of a large electricity utility. The case illustrates the achievements of various ordinary and strategic activities that progressively constituted a prospective technological narrative. It also describes how this narrative was progressively disseminated and instituted through various communicative activities. In essence, we illustrate how a technological vision – a meaningful narrative representing an organizational and technological configuration situated in the future – is constituted through a process of recursive enactments of anticipation and dissemination.

By bridging the fields of STS and OS, we contribute to both literatures on multiple fronts. Empirically, we shed light on how the settings of organizations and its embedded agencies give rise to prospective technological narratives, thus advancing the STS field of technological expectations. Furthermore, by using the zoom in/out framework (Nicolini 2009), we illuminate the value of an OS practice-based orientation for the study of prospective technological narratives. Finally, our engagement with STS literature allows us to explore the relatively underexplored organizational phenomenon of technological visions.

2. Emerging technologies and technological visions: An STS perspective

Emerging technologies have long been a central topic of investigation in STS. A critical feature that makes emerging technologies problematic is their inherent ambiguous and uncertain nature (Srinivasan 2008). These attributes stem from the fact that emerging technologies are in constant evolution; their form and meaning are in constant metamorphosis. As Bailey et al. (2022, 2) state, emerging technologies are "always emerging in the sense that they have never been 'complete' or stabilized for long". This implies that an emerging technology in the present manifests as a temporary stabilization of its process, an incomplete instantiation of a technology-in-process-of-becoming. There is thus a need for mechanisms that enable organizational actors to anticipate emerging technologies, their future form and meaning, as well as their roles and consequences within their organization.

STS scholars in the field of the sociology of technological expectations explore these matters notably by examining the role of prospective narratives – including promises, expectations, and visions of technological futures – as mitigating factors vis-à-vis the ambiguity and uncertainty of emerging technologies (Borup et al. 2006). As Borup et al. (2006, 285) assert, emerging technologies "do not substantively pre-exist themselves, except and only in terms of the imaginings, expectations and visions that have shaped their potential". Technological visions, which are one of the main ways prospective narratives manifest can be defined as schemes relating to a technological concept that are communicable, representing expectations and future goals, and expressing the means through which these goals will be achieved (Berkhout 2006). In addition, authors in this field advance that technological visions play a constitutive role in shaping innovation activities in the present. By setting expectations about the future, visions mitigate the uncertainties inherent to emerging technologies. They afford and constrain agency toward a space of possibilities, a stable frame for setting objectives, evaluating progress and bringing together actors and resources towards their achievement (Joly 2015).

A crucial question surrounding the acknowledgment of technological visions and their role in the development and integration of emerging technology pertains to the process in which they form. Again, the STS literature points toward the role of anticipation practices which have been found to participate in the construction of prospective narratives such as technological visions (Alvial-Palavicino 2016). Anticipation, as defined by Alvial-Palavicino (2016) and Anderson (2010), is the process in which ideas, assumptions and expectations about uncertain futures are constructed based on present knowledge in the aim of governing present but future-oriented processes such as innovation. In its performance, anticipation can manifest in explicit and implicit manners (Alvial-Palavicino 2016). Explicitly, anticipation involves deliberate, future-oriented strategizing activities like technological roadmapping, which clearly aim at demarcating a future trajectory. On the other hand, implicit anticipation occurs unintentionally through ordinary organizational activities, like funding a specific project aimed at developing a prototype. While not explicitly stating expectations for the organization's future, this kind of activity still influences the orientation and intention regarding the future in an emergent manner by demonstrating interest towards specific technological futures.

Furthermore, according to STS, technological visions are performative in that they mobilize actors and resources towards accomplishing the technological trajectory they promote (Borup et al. 2006). However, it is only when a technological vision reaches a collective level of agreement and acceptance that it achieves authoritative and coordinative effect (Konrad 2006). At this level, behavior that contributes to the achievement of the vision become *de facto* legitimate while those who fall outside its scope become normatively and morally deterred (Berkhout 2006).

Building on this observation, Konrad (2006) suggests that a vision reaches collectiveness through dissemination practices. Dissemination enables the propagation and legitimation of prospective narratives within a technoscientific field, and thus the enrollment of actors towards a specific technological future. This practice can manifest in an explicit or implicit manner. Explicitly, dissemination involves the deliberate promotion of specific technological futures with the intent of enrolling actors towards its materialization. On the other hand, implicit dissemination occurs through the enactment of ordinary activities that signal interest in a specific technological future. This implies that dissemination can manifest as rhetorical

practices (e.g., communication within mass media and technoscientific fields) as well as innovation practices (development, adoption, and use of emerging technologies).

Although the field of STS has extensively investigated the phenomenon of technological visions on the broad level of technoscientific fields, it is still unclear how visions emerge and spread over time, the forms in which they manifest, and the consequences they generate on innovation practices within the setting of organizations. This is surprising considering that visions and other forms of prospective narratives are central mechanisms in innovation processes such as the development and adoption of emerging technology. Above all, we contend that a large part of the technoscientific activity that brings about emerging technologies occur in the setting of organizations. STS stand to benefit significantly from delving into a more profound comprehension of the organizational activities which play a pivotal role in shaping a technological vision at the organizational level, with the potential to extend their impact into a broader field-level vision. That being said, adopting a practice-based approach (Schatzki et al. 2001) proves to be an effective conceptual framework to examine the intricate organizational dynamics that drive the constitution of a broader-level technological vision.

3. Zooming in, zooming out: A practice view on technological vision in organizations

A practice-based approach can be defined as a theoretical framework that focuses on analyzing human activities to understand the constitution of social phenomena. This perspective emphasizes the interconnectedness of actions, meanings, and the material setting in which practices unfold, offering a holistic understanding of how individuals and collectives engage in and shape various forms of activity over time (Schatzki et al. 2001). Simply put, a practice refers to a recursive sequence of activities imbued with meaning and knowledge. These activities are performed by actors in a situated manner: their actions are both enabled and constrained by the specific social and material settings in which they are enacted (Nicolini 2012). Scholars taking a strong orientation of this perspective advocate for considering practices as the ontological drivers that constitute organizational reality, and thus, as the fundamental unit of analysis when studying organizational phenomena (Feldman and Orlikowski 2011).

Therefore, the practice lens directs our analytical attention to the practical achievement – coherent series of interconnected discursive and material performances – that shape a technological vision and drives its unfolding through space and time. The strength of the practice lens lies in its ability to delve into the intricate meaning-producing agencies that bring into existence what is recognizable as a technological vision. By doing so, we bridge the so-called "micro" level of agency and "macro" level of technological visions.

One way to make practices and their constitutive effects visible in the study of technological visions within organizations is through the analytical framework of zoom in/out. This toolkit developed by Nicolini (2009) aims to explain organizational phenomena through the combined analysis of detailed and situated episodes of organizational performances with broader accounts of organizational configurations. By zooming in, we are invited to focus on

the intricacies of performances, therefore analyzing the oriented nature of work and interactions accomplished by organizational members, the manifestation of norms and knowledge through practical achievement, and the enabling and constraining role of material artefacts. Zooming out, on the other hand, involves taking a step back and considering the larger patterns and structures that emerge and unfold on an organizational level, thus examining the organizational/technological configurations that are temporarily stabilized as well as the possibilities that are afforded in terms of subsequent practices.

A practice-based exploration of organizational manifestations of technological visions through the zoom in/out framework holds the potential to enrich discussions in both STS and OS concerning emerging technologies. On the one hand, given the growing interest in the study of emerging technologies (Bailey et al. 2022), OS could significantly benefit from zooming in on the anticipatory practices that shape organizational responses to future-situated emerging technologies. On the other hand, STS stands to benefit from zooming into the practical accomplishments of anticipation and dissemination, shedding light on the enactments that actively contribute to the formation of technological visions.

4. Research design

To answer our research question, we analyze a single case study of a technological vision elaboration process carried out over two years within EnerRD[1], a research institute within a large electric utility, EnerCo. The latter has a dominant market position in the production, transportation, and distribution of electricity in North America. EnerRD's research and development activities are aimed to support and enhance the operational processes of the company's business units, whether it is a question of, for example, improving the life span of assets, increasing their efficiency, or to accelerate the electrification of its market in order to rise potential sales.

In order to follow the phenomenon as it unfolds naturally in its concrete context, we took an ethnographic stance to the data collection (Cunliffe 2010). As undisguised observers, we insured a steady presence within EnerRD three to four days a week for two years. We carried out immersive observations during the entire process of elaboration of its technological vision to tap into the discursive and material practices which progressively drew boundaries around an organizational technological vision (Suchman 2007). Our strategy also aimed at accounting for the multiple forms in which the organizational technological vision crystalized at different points in time and space (Mol 2002). In fact, we especially paid attention to the temporary meaningful artefacts through which the organizational technological vision materialized and how those instantiations afforded subsequent agencies.

Participant and non-participant observations were complemented with 27 semi-structured interviews aiming at revealing the motivations and meanings that underlie the observed activities (Langley and Meziani 2020). Interviews also enabled us to triangulate the initial insights that emerged from the observations. Finally, access to the company's internal documentation that were part and product of the process of developing the technological vision – especially the documents that emerged from workshops and meetings – enabled us to account for the temporary materializations of the organizational technological vision (Prior 2008).

The research site of EnerCo is appropriate for investigating our research question for two main reasons. First, EnerCo is a technology-driven organization evolving in an uncertain technological environment. Recent transformations in the global electricity sector driven by new technologies for electricity production and management have given rise to new business models and have disrupted utility sectors in North America. Technologies such as photovoltaics, two-way smart power grids, and home automations systems are threatening the traditional centralized utility model where power is produced, transported, and distributed through colossal infrastructures owned by big companies. Even for well-established utilities such as EnerCo, these new technological trends are raising questions and challenging the way they operate and their market positioning.

In this context of great technological uncertainty, a discourse advocating technological innovation emerged and became a watchword within EnerCo. Since the mid-2010s, EnerCo executives have been engaged in efforts to mobilize the business units – which include Production (EnerPro), Transportation (EnerTransport) and Distribution (EnerDis) – towards positioning technological innovation at the center of their strategy. However, technological innovation in contexts of organizational complexity and environmental uncertainty necessitates having a good sense of awareness regarding the technological domains and trajectories it wishes to engage in. EnerCo is accustomed to carrying out technological prospection initiatives with the aim of facilitating its navigation through the uncertainties related to innovation. It is in this line of thought that EnerCo carried a technological innovation planning exercise which spanned over two years aimed at establishing a long-term technological vision for the entire organization which would align its research center's (EnerRD) innovation efforts with the business unit's objectives.

Although we describe this accomplishment in more detail in the findings section, Figure 1 illustrates the three main phases that composed the two-year process that we followed. Our inquiry started when EnerRD was mandated by EnerTransport to formulate of a long-term technological strategy for the electricity transportation system. The initiative which was named the Vision Network 2035 rapidly stimulated interest within and beyond EnerTransport. This motivated EnerRD to enlarge the strategic process to the rest of the business units with the aim to build the Organizational Technological Vision for 2035 (OTV 2035) that encompasses future issues that pertain to the whole organization. Finally, once this was established, interrogations about how to operationalize the technological vision, to translate the strategy into concrete projects, pushed EnerRD to launch the Organizational Technological RoadMapping endeavor (OTRM). The objective of this enterprise was to deconstruct the long-term and high-abstraction vision into precise technological objectives and tangible innovation projects to initiate in the short, mid, and long term.

Figure 1.
Three phases in EnerCo's technological vision construction process.

5. Zooming in: Practical achievements of anticipation and dissemination

The data analysis strategy was based on the idea of tracking the activities that bring into existence a technological vision in an organization. To do so, we first mobilized our data to reconstitute a chronological narrative that accounts the observed process. From this narrative case study spanning two years of organizational life, we then zoomed in towards various representative episodes of the vision constitution process in order to understand the key activities that compose it. In this section, we showcase two examples of representative episodes to expose the practices of anticipation and dissemination and how these practices enabled a technological vision to exist as something coherent and cohesive within an organization.

5.1 Zooming in: Anticipation practices in technological roadmap workshops

Jane and Rob arrive in a teamwork room full of other employees from all divisions. A few weeks earlier, they all received a formal invitation from the senior director of EnerRD to participate in a strategic workshop: "*You are cordially invited to take part in the official launch event of the joint [EnerRD] and business unit reflection process aimed at defining the roadmaps resulting from the orientations of the Organizational Technology Vision 2035*".

The email emphasized that the resulting roadmaps would become the guiding tool for the company's subsequent innovation activities and that it was crucial to include the divisions' input on future technological needs. Jane and Rob join a six-person table which comprises EnerRD researchers, managers from different divisions, and an external facilitator.

The meeting begins with a presentation from Luca, the EnerRD coordinator of the technological vision and roadmapping initiative. Luca starts by describing the work accomplished before this workshop: EnerRD researchers delineated a preliminary version of the technological roadmap internally based on their own technological forecasts. In fact, Luca explains that they named this roadmap the "version 0.9" since it is nearly complete, although missing the divisions' input in order to become a definitive "version 1.0". In this line of thought, Luca reiterates the workshop's objective which is to collect input on the division's future technological needs in order to improve the roadmap.

After this introduction, the ideation work begins. The main facilitator explains that the work session is organized around four phases, each one addressing a question about the future of the organization. For each phase, the team facilitators will lead participants to brainstorm individually by jotting their ideas on post-it notes. This will be followed by a discussion where participants share and debate their ideas while the facilitator synthesizes their statements on a purposefully designed brainstorming template.

In the first phase, Jane and Rob's facilitator launches the discussion with the following question: "*What are the social, economic and technological changes that you expect facing within your work at EnerCo in the course of the next fifteen years?*" In their group, discussions quickly focused on the emergence of new technological trends such as connected homes, autonomous and electric transportation and microgrids. They also expanded onto other major trends such as extreme climatic phenomena, energy scarcity and the evolution of work habits such as telecommuting.

Having shed light on these future contextual issues, the participants are asked to think about how these environmental changes will translate into issues and disruptions for the organization and how resolving these issues can create value for EnerCo, its clients and society. Rob recalls that at this point, there is a lot of debate in their team about how certain developments will affect business operations. They were not sure, for example, if EnerCo will be able to efficiently manage a more complex grid of diverse energy sources and increasing self-producing customers. What about the presumed arrival of hydrogen fuel production and the rise of Bitcoin mines? Will EnerCo have the capacity to increase its production enough for these new markets? These future business and technological issues really stimulated the conversation in this second part of the workshop.

In the third phase, the facilitator asks the participants to propose technological capacities that EnerCo needs to develop in the long term to cope with the future disruptions raised earlier. This discussion is also very intense especially because division managers want to make sure that the needs that pertain to their work domain are taken into account in the organizational roadmap. For instance, EnerPro members insist on the development of artificial intelligence technologies that would help them monitor consumption peaks to optimize electricity production. In contrast, the more client oriented EnerDis participants focus on home automation systems which would enable them to monitor client consumption and nudge them towards energy saving behavior. Sometimes, as this quote from Jane demonstrates, it is simply the way statements were worded on the team template that provoked debates:

> It was sometimes frustrating, because we spent a lot of time discussing the right word, the right phrase to put on the template to characterize these developments, as we did not understand them in the same way between the different divisions.

Finally, in the last phase, participants are asked to collectively converge towards a one-sentence-statement that describes how they envision EnerCo's technological DNA in 2035. After several iterations, Jane and Rob's group finally agree on the following statements: "*A service provider beyond the kWh, with an integrated view of the entire grid, shaping tomorrow's strategies by becoming a reference in asset management*". After two hours of workshop, each team shares in turn the result of its ideation process to the rest of the group. A brief discussion is opened after each team statement to extend and challenge the technological vision that was proposed. Emily, a participant from EnerRD, says after the workshop:

> I think the cross-presentations really made everyone think, because we could see in the anticipated scenarios that there are [...] areas where we do not currently have skills and where we will have to position ourselves.

Finally, the workshop ends with an invitation by Luca to participate in a second workshop in two weeks that will aim to integrate this workshop's output into the "version 0.9" of the roadmap, thus instituting the definitive OTRM.

5.2 Zooming in: Dissemination practices within a kick-off meeting for the elaboration of an innovation project portfolio

A few weeks after the roadmaps were established, the business units launch their annual update of research and development project portfolios. The objective of this process is to decide how to allocate each business unit's innovation budget to a set of R&D projects that will be undertaken by EnerRD. Besides the budget constraint, the business units determine their project portfolio according to their needs, requirements, and priorities. However, that year, a new constraint framed this process: the business units were given the directive by top management to align their project portfolio with the newly ratified roadmaps.

At EnerCo's distribution division (hereafter EnerDis), two senior managers of the department of technology integration, Jane and Rob, were appointed to lead this process. Their involvement in the OTRM workshops where they actively advocated for EnerDis' technological needs and requirements made them good candidates for bringing in the new strategy directives. However, the two managers were confronted to a dilemma: the project portfolio had to meet EnerDis's technological needs while also being aligned with the organizational roadmap's trajectory. On one side, Jane and Rob had to include key EnerDis members capable of inputting the portfolio with projects that will satisfy EnerDis' various needs pertaining to its operations. On the other side, the EnerDis members capable of planning future innovation projects were unfamiliar with the roadmaps since they had not participated in the roadmapping workshops.

Therefore, Jane and Rob needed a way to consult the EnerDis community for their technological needs at the same time as making members that were not involved in the workshops aware and knowledgeable of the content of the technological roadmap. With this aim, they decided to organize a kick-off meeting to attract the attention and engage the EnerDis community towards the portfolio elaboration process. A second objective was also to make a call for collaboration between EnerDis employees and EnerRD researchers – the former being the ones who will benefit of the innovation project portfolio and the latter being the experts who will operationalize the projects portfolio. The kick-off meeting took place at the EnerCo headquarters and virtually on a videoconference platform. It was open to all the EnerDis division. Actors present at the meeting included many members of EnerDis's top and middle management as well as many EnerRD researchers involved in the elaboration of the roadmaps.

After an introduction by Jane, the meeting took the form of a conference with a sequence of presentations. The first presentation was done by an EnerRD vice-president responsible of the R&D relationship between EnerRD and EnerDis. As a foreword to the subsequent presentations, he narrates the process of vision building and roadmapping that had occurred in the last months which gave rise the OTV 2035 and the OTRM. He continues by explaining the purpose of the portfolio elaboration process to come:

> It is this transversal vision that will guide our innovation projects in the short and medium term, but it is also your innovation projects that will feed it and transform it in an iterative way in the future.

By saying so, he reiterates the importance of aligning the portfolio with the OTRM which represents the company-wide technological strategy.

The second exhibition was given by Luca, the EnerRD vision and roadmap coordinator. His presentation, aided by a visual illustration, unveiled the content of the OTRM, exposing chronologically the technological capacities to be attained in the short, medium, and long term as well as the innovation activities to be deployed in order get there. To make the vision contained in the roadmap more concrete and precise, for every one of the eight technological domains of the OTRM, a researcher from EnerRD with an expertise in the research area showcases examples of ongoing or finished R&D projects that contribute to the accomplishment of the set objectives. These presentations demonstrate how R&D projects can contribute to EnerDis' strategy and operations while being aligned with the OTRM's vision thus benefiting the company as a whole.

To close the kick-off meeting, Jane stated again the importance of aligning EnerDis' innovation strategy with the OTRM and called for collaboration between the business unit and the EnerRD community within the portfolio elaboration process:

> It is really by starting to work together, in a joint manner, that we will be able to initiate a strong portfolio of projects that meet the various ambitious objectives that we have set with the roadmaps.

Finally, she announced the next steps of the portfolio elaboration process, namely the holding of work meetings between Distributions members and EnerRD researchers in order to establish the projects that will figure in the portfolio.

6. Zooming out: How anticipation and dissemination relate and constitute a technological vision

The narrative episodes presented above enable us to zoom in on how anticipation and dissemination performances are achieved (Nicolini 2009). However, the activities described in the above episodes are only a small part of much wider process. To understand the phenomenon of organizational technological visions, we must push beyond the simple illustration of practical accomplishment. As Nicolini (2009) explains, practice theory must also establish how practices are entangled inside the mesh of organizational life, as well as how practices achieve specific organizational and technological orderings. To do so, it is necessary to extend our spatiotemporal scope of analysis or, as Nicolini (2009) calls it, to "zoom out".

In the following section, we present a concise version of our narrative case study (summarized in Figure 2) which gives the readers the opportunity to experience the process of constitution of a technological vision within EnerRD. The objectives of zooming out are first to acknowledge the recursivity of anticipation and dissemination practices throughout the process. Second, we want to derive explanations as to how the practices of anticipation and dissemination relate with each other and illustrate how this mesh of practice performs a specific organizational phenomenon: a technological vision.

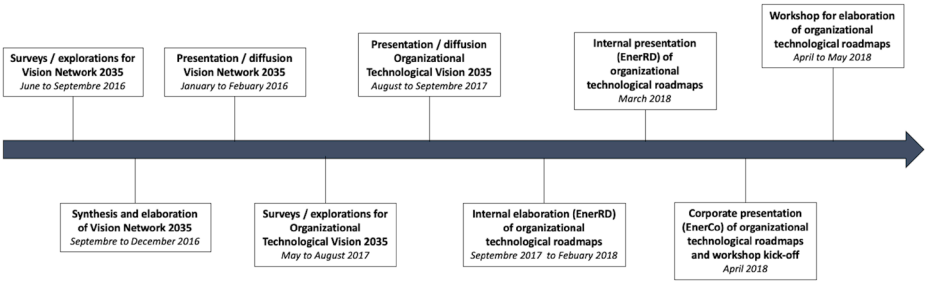

Figure 2.
Chronology of events in the constitution of EnerCo's technological vision.

6.1 The process of constituting EnerRD's technological vision and roadmaps

In 2016, EnerRD was mandated by EnerCo's Transportation division (here after EnerTransport) – business unit responsible for moving energy from the production sites to the client distribution network – to elaborate of a long-term technological strategy for the electricity transportation system, the Vision Network 2035. The purpose of this mandate was to revisit and update a strategic planning exercise done fifteen years earlier to chart new major technological directions and guide future research and development projects regarding the maintaining and optimizing of the electricity transportation network.

To accomplish this task, EnerRD entrusted a team of researchers from various fields in a spirit of interdisciplinarity. This team elaborated the Vision Network 2035 by first surveying key actors of the research institute and EnerTransport for their ideas of future technological trends that would affect the transportation network in the long run. They thus established a base of individual visions of the future held by various actors in the company. This survey was then followed by a phase of evaluation and organization of the collected information. To better make sense of it, they proceeded to ordering the various ideas into sensible categorizations which enabled them to configure a vision carried by a sensible narrative uncovering long-term targets and a scenario for an innovation trajectory that would bring them there.

This was then transposed into high-level corporate documents. Amid strategic questioning within the division, this scenario suggested an ambitious vision of the technological development to adapt the electric network to future potential disruptions. This first version of the vision was presented in December 2016 to divisional management and quickly won its support. While this approach was still focused on the development of EnerCo's electrical transportation network, the technological vision incorporated many transversal issues for the entire company. The team in charge was thus asked to present the Vision Network 2035 to the other divisions (Production and Distribution). The initiative was received with genuine interest among division managers who saw in this process means to better make sense of future technological breakthroughs.

In May 2017, a new director took over the general management of EnerRD. In a spirit of aligning EnerRD's activities with divisional strategic issues, the director decided to reignite the Vision Network 2035 initiative with the objective of enlarging this strategy established for EnerTransport into an organizational technological vision which would encompass EnerCo's technological needs and objectives as a whole. Such a strategy tool could then be used for guiding and coordinating EnerRD's innovation activities, thus solving the alignment issues between its research activities and business units' operations.

This new initiative is entrusted to the same team that led Vision Network 2035. The team reproduced the approach that was initially taken. However, this time, they intend at surveying the technological needs and issues of a wider scope of organizational actors. The expansion of the technological vision elaboration was notably enabled by an additional set of interviews with technoscientific domain experts, but also through carrying out collaborative workshops. The latter aimed to enlarge the surveying but also to facilitate acceptance of the vision in process. Finally, the establishment of an online sharing platform enabled actors to follow the development of the vision in real time and make propositions.

As for Vision Network 2035, information collection was followed by a phase of classification where ideas where organized following three "orientations" (technological domains) and eight "targets" (long-term technological capacities to attain). At the end of August 2017, a relatively stabilized version of the Organizational Technology Vision 2035 (OTV 2035) is established. A presentation and a narrative that underlie the vision are formatted in an Excel summary file and in a PowerPoint presentation. The OTV 2035 is widely presented internally to EnerRD employees and to all the company's divisional management committees.

With the establishment of the OTV 2035, important operational and strategic issues became apparent. The high-level strategic narrative projecting long-term technological objectives and trajectories were of little use for the development of innovation project portfolios and therefore difficult to deploy and operationalize. This issue therefore motivates EnerRD to develop roadmaps capable of translating the long-term vision into shorter-term actionable targets, as well as materializing the vision into a strategic management and communication tool that can facilitate the coordination of innovation activities. This Organizational Technological Roadmap (OTRM) initiative is deployed in two phases: a first phase for the development of preliminary roadmaps internally at EnerRD by the researchers, then a second phase to open the reflection to the various business units through workshops to incorporate their perspectives and to obtain their engagement towards this new strategy tool. The additional content is then synthesized by the EnerRD task force and materialized in an excel management tool and a corporate presentation. Finally, the OTRM is then sent to all the workshop participants to endorse the content, and then distributed more widely within the company through presentations and virtual platforms.

7. Discussion: Organizing a technological vision

The zooming in and zooming out approach (Nicolini 2009) enabled us to make sense of the practices that enact the constitution of an organization-wide technological vision. Through

descriptive example we first zoomed in on accomplishment of anticipation and dissemination practices. Then, by zooming out towards a wider span of organizational life, the case study shows how anticipation and dissemination practices are recursive and consequential in the process of constituting an organizational technological vision. The following section analyzes the previous empirical narratives and derives theoretical insights about the practices of anticipation and dissemination as well as their constitutive effects on organizational technological visions.

7.1 Anticipation practices

According to our observations, the practice of anticipating manifests in various ways, such as gathering information on the state of a technoscientific field, conducting interviews with experts, and establishing forecasts about the future. In fact, by zooming in on a representative episode of anticipatory activity, we showed that anticipation goes beyond the simple acquisition of information about the future, the transposition of a factual future into the present. Since the future is an ambiguous and uncertain object, anticipating is an active and creative process comprising activities such as prospective imagination of possible future trajectories that technologies and the organization might take. We thus contend with extent STS literature that anticipation practices are future-oriented activities that attempts at envisioning and making sense of a future sociotechnical state based on present knowledge (Alvial-Palavicino 2016). On top of that, by zooming in on the enactments of anticipating within an organization, we were able to better shed light on the micro-politics of future-making. Anticipating technological futures involves evaluating and prioritizing potential future technological evolutions which therefore implies the foregrounding of some scenarios over others. In organizations, where technological issues and needs are different from one function to the other, anticipating is necessarily interest-laden: as we have observed in the workshops, it is intwined with political efforts to negotiate, contest and control the way prospective narratives are produced (Azad and Faraj 2011).

Nonetheless, the activities we describe in the first "zooming-in" section are only illustrative of a wider and recursive practice. By zooming out towards our larger case study, we were persistently confronted to activities that enabled the anticipation of future technological trajectories throughout the process of constitution of the technological vision. In fact, other than during the OTRM workshops, we noted anticipations practices also manifested in the prospective interviewing and evaluation activities during the Vision Network 2035 and OTV 2035 initiatives which enabled the gathering of individual visions of the future held by experts in the company, and order, prioritize, and synthesize them into convergent and coherent collective visions. This indicates that practices of anticipation are recursive and a central part of the process of technological vision constitution within organizations.

Integrating the study of technological anticipation within organizational contexts reveals a crucial insight: the dynamics of anticipating *technological* futures are intricately intertwined with anticipating *organizational* futures (Orlikowski 2007). The process of framing future technological advancements is inseparable from envisioning the future trajectory of the organization itself. In fact, as our observations of the OTRM workshops indicate, present and future organizational realities, issues, problematics – as perceived and experienced by the actors who perform the anticipation practices – afford and constrain the way in which

future technologies are anticipated. This implies that the practice of anticipating emerging technologies is entangled in a mesh of organizational processes and practices that afford and constrain how it is enacted and the effects it performs. Thus, anticipating emerging technologies within an organization involves setting ideas, expectations, imaginaries regarding possible configurations of organizational *and* technological elements situated in the future as well as possible trajectories that lead to it.

As suggested by STS literature, the case study also illustrates that anticipation practices play a constitutive role in the emergence of organizational technological visions. By setting expectations about emerging technologies and their entanglement in the organizational mesh, anticipation practices produce narratives that enact technologies as desirable or menacing, as having certain functions, uses, value, as resolving or creating specific issues within the organization. In fact, we argue that anticipation is more than simple construction of meaning regarding the future. It transcends the boundaries of a purely imaginative exercise confined to a semantic dimension. Above all, anticipation involves relational and communicational dynamics in which technological futures are materialized as objects of reflection, negotiation and design (Ashcraft et al. 2009). Anticipation enables the invocation and engagement with the material past and present in order to extrapolate, constitute and materialize a meaningful vision of the future.

Finally, anticipation practices are performative: they have material effects on the temporary organizational configuration and therefore on the manner in which subsequent agencies can unfold. As our case study indicates, anticipation generates outcomes and artefacts such as official documents, presentations and management tools that crystallize and materialize a temporary instantiation of the technological vision. These organizational artefacts allow the preservation of traces of the anticipation activities by reifying the knowledge it encompasses and produces, therefore facilitating the visualization and dissemination of an organizational technological vision. By manifesting the vision at a specific moment in time, these artefacts also afford and constrain subsequent anticipation practices (Nicolini et al. 2012). In our case study, this was manifested notably when the Vision Network 2035 influenced the elaboration of the OTV 2035 which guided the establishment of the OTRM which finally gave the direction for the elaboration of innovation project portfolios.

7.2 Dissemination practices

By zooming in on a particular accomplishment of dissemination practices, we were able to observe how various prospective narratives were moved beyond the original setting of their production and how this movement was constitutive of a collective technological vision at the organizational level. In fact, the dissemination practice vignette unveils the trajectory of the OTRM, initially rooted in its production site within roadmapping activities conducted by EnerRD researchers and workshops at EnerCo's headquarters. However, its narrative found new relevance when transposed to a different arena – EnerDis's innovation project portfolio elaboration activity. This transition was orchestrated through presentations of the OTMR by pivotal actors during the portfolio elaboration process's kick-off meeting. In addition, the vignette captures the distinctive nature of each site entwined in the dissemination dynamics: each unit of the organization consists of a unique social context, composed of its

individual codes, meanings, norms, objectives, and political interests, thereby intensifying the complexity of the translation process. In this context, the practice of dissemination comprises activities that enable the "translation" (Callon 1986) of a vision into new settings, rendering it meaningful, legitimate, and interesting for new groups of stakeholders, with the aim of enrolling and mobilizing them towards a specific technological trajectory.

This practice is usually performed by key organizational actors that play boundary spanning roles at the intersection of the site where anticipation is produced and the site where it is disseminated. In other words, these boundary actors are people that have the legitimacy and knowledge to translate a technological vision from the world where it is produced – which is imbued with the interest of those who produced it – to a new sociopolitical world – which do not necessarily have the same interests (Levina and Vaast 2005). This boundary spanning process is afforded and constrained by a range of organizational artefacts that reify prospective visions into visible and tangible objects (examples from the case study include PowerPoint presentations, corporate documents, meeting reports, workshop templates, roadmaps) (Nicolini et al. 2012).

Aside from the idiosyncratic episode of the kick-off event, the activities we analyze in the second "zooming-in" section are representative of a recursive dissemination practice. By zooming out, we notice that dissemination practices came up repeatedly throughout the case study – sometimes occurring more implicitly. Per example, we noted as manifestations of dissemination the uploading of working versions of the OTV 2035 on the company's virtual platform, emailing official documents that summarize the OTV 2035, presenting the Vision Network 2035 to corporate committees, explaining the work done priorly for the OTV 2035 at the OTRM workshops, or simply through conversations between EnerRD researchers and business unit managers during the OTRM workshops.

Thus, dissemination practices play a central and recursive role in the constitution of an organizational technological vision by enabling the convergence of various actors towards a coherent and collective technological vision (Berkhout 2006; Konrad 2006). Dissemination expands the audience of a vision beyond the social, physical, and temporal site of its production, into new social worlds. It allows larger scopes of actors to become aware and interested in the vision and to take part in the vision constitution process. This is notably manifested in the case study as the process of constituting a vision expands from a strategic initiative bounded within one business unit (Vision Network 2035) to organization-wide vision-setting (OTV 2035) and roadmapping initiatives (OTRM).

However, dissemination not only transfers the vision as information into new contexts but also performs a translation role: it attempts to problematize other actors' future and their relation to emerging technology; it attempts to enroll and mobilize them towards a specific vision of the future (Denis et al. 2007). In other words, dissemination aims to influence how actors make sense of the future to generate a collective sense of direction and engagement towards the fulfillment of a technological vision. This was particularly showcased by EnerRD's efforts to included and engage the business units in the roadmapping workshops with the aim of obtaining their acceptance and enrollment.

In this sense, by providing potential new followers and advocates for the vision, dissemination practices bring a technological vision closer towards the point of collectiveness. In fact, disseminating a vision to the point where it is known and accepted by a majority of

members within an organization grants it the attribute of a collective or organizational vision. By trending toward this critical point, a technological vision gains performative power; meaning that it becomes more inclined to have configurational effects on an organization and its technological trajectory. In other words, dissemination practices set discursive expectations about the future at an organizational level which are met with material actions with material consequences. A technological vision affords and constrains specific organizational actions vis-à-vis technology, therefore participating in moving things and people towards the accomplishment of the specific future trajectory comprised in the vision (Borup et al. 2006). Thus, dissemination not only moves meanings; it is as much material as discursive.

7.3 A processual model of the constitution of a technological vision in an organization

Zooming in allowed us to grasp the discreet roles and consequences of anticipating and disseminating. However, to truly comprehend the bigger picture, zooming out is essential (Nicolini 2009). In light of this, we propose a processual model that emphasizes the interplay and recursion of anticipating and disseminating practices in the formation of a technological vision (see Figure 3).

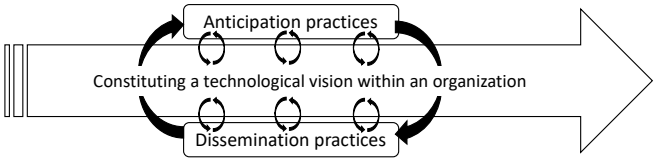

Figure 3.
The role of anticipation and dissemination practices in the constitution of a technological vision in an organization.

As illustrated by our findings, the model indicates that a technological vision is an ongoing process. The framing of an organization's technological trajectory remains fluid, molded by the continuous interplay of anticipating and disseminating activities. Nevertheless, the model does not fully capture how this process is deeply embedded within broader organizational and environmental dynamics. Indeed, an organization's framing of its technological trajectory is subject to constant evolution, influenced by a complex web of social, political, cultural, economic, technical, and scientific contingencies over which it exerts only a minor degree of control. Understanding these broader mechanisms becomes crucial to extend and refine our findings.

Furthermore, our research not only reveals how anticipation and dissemination practices participate in formulating a future trajectory for the organization, but also indicates a reciprocal influence on each other's achievements. In essence, the way a specific performance of anticipation unfolds shapes the technological vision's configuration, within which a subsequent dissemination performance can operate. It establishes a sociomaterial setting that enables and

constrains the manner in which disseminating can be performed. Conversely, the enactment of disseminating a technological vision also produces effects on the social and material order, which inevitably shapes and frames subsequent anticipating performances. The outcomes and repercussions of dissemination actions inform the understanding of what can be expected or accomplished in future anticipatory efforts. This dynamic interplay between anticipation and dissemination forms a continuous feedback loop, wherein each practice continuously informs and refines the other. As a result, the process of envisioning and realizing a technological trajectory becomes an intricate dance between the two practices, with each step influencing the next.

8. Concluding remarks

This study engages with both STS and OS lenses to enhance our comprehension of how technological visions take shape within an organization. Building upon the rich sociological literature on technological expectations within STS (Borup et al. 2006), we propose a fresh outlook to the study of technological visions by investigating their formation within the context of organizations and by adopting a practice-based lens which we operationalize through the zoom in/out approach (Nicolini 2009).

By adopting an OS conceptual framework, our study makes a significant contribution to the field of STS in three distinct ways. Firstly, we delve into a finer-grained analysis of a phenomenon that has traditionally been studied at broader levels of analysis. Rather than examining technological visions solely on a field level, our research reveals that these field-configuring discourses emerge as a result of the active efforts of organizations seeking to navigate uncertain technological futures. We reveal that the process of making sense of uncertainty and the establishment of a unified narrative for an organization's technological trajectory are intricately intertwined with the mundane but complex everyday routines, interactions, and dynamics within the organization.

By linking the OS lens with a STS empirical object, we transcend the limitations of the micro/macro dualism that has often complicated academic discussions (Feldman and Orlikowski 2011). Instead of artificially separating the field-level technological vision from the ongoing organizational practices that give rise to it, we illustrate their inseparability. In doing so, we provide a compelling and valuable demonstration of how technoscientific and organizational dynamics are intricately entangled and mutually shaping.

Secondly, our study contributes both conceptually and methodologically to the field of STS by highlighting the value of adopting an OS orientation to practice theory (Nicolini 2012) and utilizing the zoom in/out framework (Nicolini 2009). Through this approach, we acknowledge the mutually constitutive relationship between practices and technoscientific/organizational phenomena, exemplified in this case by the constitution of technological visions within organizational settings. Zooming in on specific episodes of practical achievements allows us to gain insights into the internal dynamics of key organizational practices – in this case, anticipation and dissemination. Simultaneously, zooming out to analyze broader organizational patterns reveals the performative effects of these practices on the configuration of technoscientific outcomes – in this case, a technological vision. Therefore, this research

demonstrates that the zoom in/out approach serves as a valuable conceptual and methodological toolkit for establishing connections between OS and STS. It enables us to effectively investigate and comprehend how field-level technoscientific phenomena, which have traditionally been the focus of STS, are intricately intertwined with and influenced by intra-organizational dynamics – an area traditionally explored within OS.

Finally, our research makes a significant contribution to the field of OS by offering a novel empirical and theoretical perspective on the study of emerging technologies within organizational contexts. Inspired by the STS conversation on technological expectations (Borup et al. 2006), we demonstrate that prospective narratives concerning future-situated technological trends play a crucial role not only in technoscientific fields but also within organizations. As the interest in emerging technology and organizing continues to grow (Bailey et al. 2022), it becomes imperative to acknowledge the pivotal role of technological visions in integrating technologies-in-becoming into the fabric of organizing.

While we propose a processual model for understanding the constitution of technological visions in organizations, our study does not extensively explore the performative effects of such prospective narratives. Future research endeavors should focus on investigating these compelling questions, such as how prospective narratives at both the organization-level and field-level shape an organization's technological strategy and innovation practices. By delving into these areas, we can further enhance our understanding of the intricate interplay between technology and organizing, leading to valuable insights for practitioners and researchers alike.

Notes

[1] The names of companies and persons have been modified to protect informant's identity.

References

Alvial-Palavicino, Carla (2016) *The Future as Practice: A Framework to Understand Anticipation in Science and Technology*, in "Tecnoscienza: Italian Journal of Science & Technology Studies", 6(2), pp. 135-172.

Anderson, Ben (2010) *Preemption, precaution, preparedness: Anticipatory action and future geographies*, in "Progress in Human Geography", 34(6), pp. 777-798.

Ashcraft, Karen L., Kuhn, Timothy R. and Cooren, François (2009) *Constitutional amendments: "Materializing" organizational communication*, in "Academy of Management Annals", 3(1), pp. 1-64.

Azad, Bijan and Faraj, Samer (2011) *Social power and information technology implementation: A contentious framing lens*, in "Information Systems Journal", 21(1), pp. 33-61.

Bailey, Diane E., Faraj, Samer, Hinds, Pamela J., Leonardi, Paul M. and von Krogh, Georg (2022) *We are all theorists of technology now: A relational perspective on emerging technology and organizing*, in "Organization Science", 33(1), pp. 1-18.

Berkhout, Frans (2006) *Normative expectations in systems innovation*, in "Technology Analysis & Strategic Management", 18(3-4), pp. 299-311.

Borup, Mads, Brown, Nick, Konrad, Kornelia and van Lente, Harro (2006) *The sociology of expectations in science and technology*, in "Technology Analysis & Strategic Management", 18(3-4), pp. 285-298.

Callon, Michel (1986) *Éléments pour une sociologie de la traduction: La domestication des coquilles Saint-Jacques et des marins-pêcheurs dans la baie de Saint-Brieuc*, in "L'Année sociologique (1940/1948-)", 36, pp. 169-208.

Cunliffe, Ann L. (2010) *Retelling Tales of the Field: In Search of Organizational Ethnography 20 Years On*, in "Organizational Research Methods", 13(2), pp. 224-239.

Day, George S. and Schoemaker, Paul J. H. (2000) *Avoiding the Pitfalls of Emerging Technologies*, in "California Management Review", 42(2), pp. 8-33.

Denis, Jean-Louis, Langley, Ann and Rouleau, Linda (2007) *Strategizing in pluralistic contexts: Rethinking theoretical frames*, in "Human Relations", 60(1), pp. 179-215.

Feldman, Martha S. and Orlikowski, Wanda J. (2011) *Theorizing practice and practicing theory*, in "Organization Science", 22(5), pp. 1240-1253.

Joly, Pierre B. (2015) *Le régime des promesses technoscientifique*, in Marc Audétat (ed.), *Sciences et technologies émergentes: Pourquoi tant de promesses?*, Paris, Éditions Hermann, pp. 31-48.

Konrad, Kornelia (2006) *The social dynamics of expectations: The interaction of collective and actor-specific expectations on electronic commerce and interactive television*, in "Technology Analysis & Strategic Management", 18(3-4), pp. 429-444.

Langley, Ann and Meziani, Nora (2020) *Making Interviews Meaningful*, in "The Journal of Applied Behavioral Science", 56(3), pp. 370-391.

Levina, Natalia and Vaast, Emmanuelle (2005) *The Emergence of Boundary Spanning Competence in Practice: Implications for Implementation and Use of Information Systems*, in "MIS Quarterly", 29(2), pp. 335-363.

Mol, Annemarie (2002) *The Body Multiple: Ontology in Medical Practice*, Durham, Duke University Press.

Nicolini, Davide (2009) *Zooming In and Out: Studying Practices by Switching Theoretical Lenses and Trailing Connections*, in "Organization Studies", 30(12), pp. 1391-1418.

Nicolini, Davide (2012) *Practice Theory, Work, and Organization: An Introduction*, Oxford (UK), Oxford University Press.

Nicolini, Davide, Mengis, Jeanne and Swan, Jacky (2012) *Understanding the Role of Objects in Cross-Disciplinary Collaboration*, in "Organization Science", 23(3), pp. 612-629.

Orlikowski, Wanda J. (2007) *Sociomaterial Practices: Exploring Technology at Work*, in "Organization Studies", 28(9), pp. 1435-1448.

Prior, Lindsay (2008) *Repositioning Documents in Social Research*, in "Sociology", 42(5), pp. 821-836.

Schatzki, Theodore R., Knorr-Cetina, Karin and von Savigny, Eike (eds.) (2001) *The Practice Turn in Contemporary Theory* (Vol. 44), London, Routledge.

Srinivasan, Raji (2008) *Sources, characteristics and effects of emerging technologies: Research opportunities in innovation*, in "Industrial Marketing Management", 37(6), pp. 633-640.

Suchman, Lucy (2007) *Human-Machine Reconfigurations: Plans and Situated Actions*, Cambridge (UK), Cambridge University Press.