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Anticipation for Grand Challenges

An Ethnographic Study of Future-Making Practices in a Technology Company

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Visions that highlight new technological capabilities often depict frictionless futures in which data, information, resources flow seamlessly. These visions suggest that our most pressing challenges could be solved with technological fixes. However, some challenges cannot be solved by technology alone. In recent years, grand challenges have gained attention in industry and academia, with organizations pledging to address large-scale, complex, and intractable societal problems. While technoscientific advancements are typically seen as the key to achieving these goals, a more critical and systemic approach that starts with imagining alternative visions is required to address the multi-faceted nature of grand challenges. We argue that the intersection of foresight and design could provide a rich ground for fostering new ways for making alternative futures in technology companies. In this paper we explore the role of future-oriented design practices in addressing grand challenges within a large multinational conglomerate. Drawing from ethnographic research conducted in the company's Research and Development (R&D) Center in the USA, we find that grand challenges inform research and development strategies in the organization and shape the future visions they create and disseminate. We argue that while the organization shifts its R&D strategy to address grand challenges, the role of future-oriented design becomes increasingly important. We also identify the frictions that arise when introducing future-oriented design practices and explore the evolution of these practices in response to these frictions. Furthermore, we argue that future-oriented design practices explicitly showcase how pressing grand challenges are and invite stakeholders to engage with futures more critically. Keywords: corporate foresight, design futures, organizational ethnography

INTRODUCTION

Visions that highlight new technological capabilities often depict frictionless futures. In such visions, data, information, resources flow without any disruption. People, things, spaces are connected to one another seamlessly. These visions not only show what emerging technologies might enable, but also what society might look like. These visions prompt discussions about possible futures ahead, and surface our hopes and dreams, worries and fears about what might be. They surface conflicts, both present and past, and open up debates about potential implications of emerging technologies. These visions are not only illustrations of possible futures, but also inform what futures get made. Ideas and images of the future influence purposeful future-oriented human activity by informing decisions that are made in the present, which eventually play a role in the realization of that future (Voros 2007). This mechanism in which future imaginaries shape the present-day actions is

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explained by the concept of sociotechnical imaginaries. Jasanoff and Kim (2015, p.322) describe sociotechnical imaginaries are "collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology". In these imaginaries, technologies are presented as solutions to complex, societal challenges in domains such as smart cities (Sadowski and Bendor 2019), energy (Sheila and Kim 2013) and food security (Carmen, Lindberg and Selfa 2020). However, technological solutions alone could fail to address the multi-faceted and interconnected nature of such challenges.

In recent years, "grand challenges" have attracted increasing interest in industry and academia. Companies pledge their commitment to solving large-scale, societal and environmental challenges ranging from mobility to food security, from poverty to climate change. Grand challenges (GCs) are defined as large-scale, complex and intractable societal level problems (Ferraro et al. 2015; Mair et al. 2016, Stjerne et al. 2022, p. 141). These challenges do not have clear solutions (Grodal and O'Mahony 2017, p. 1801) and cannot be solved by easy fixes (Porter, Tuertscher and Huysman 2020, p. 248). Thus, tackling GCs requires long-term and continuous commitment (George et al. 2016) by a constellation of actors across institutional and disciplinary boundaries. The orientation towards GCs can be observed in the field of design. Scholars and practitioners call for reformulating design for adapting to the 21st century in order to address these large-scale systemic challenges, sometimes called wicked problems (Irwin 2015; Teixeira 2017; Norman and Stappers 2015) and to contribute to public good (Junginger 2018). Furthermore, orientation towards the future, or *not-yet-existing* is evident in design. In the Design Thinking, Design Theory Series foreword, Friedman and Stolterman claim that "within the framework of design, we are also challenged to design for extreme situations, for biotech, nanotech, and new materials, and design for social business, as well as conceptual challenges for worlds that do not yet exist such as the world beyond the Kurzweil singularity—and for new visions of the world that does not yet exist" (2017). This broadens the scope of design both temporally and spatially: designing for systemic change involves taking more stakeholders beyond the individual user, even future generations, into consideration, and imagining long-term futures.

CRITICAL FUTURE-MAKING THROUGH DESIGN

We suggest that design, as a mode of inquiry, can be leveraged to envision alternative futures. Mazé (2016) views design as a future-making activity and claims that the future "will be occupied by built environments, infrastructures and things that we have designed." She argues that design as a practice holds the power to shape possible or preferred futures. Approaches such as speculative and critical design (Auger 2013; Dunne and Raby 2013), experiential futures (Candy and Kornet 2019)

and design fiction (Bleecker 2022) have engaged with futures more critically and sought to raise more questions than coming up with short-term solutions to current problems. They illustrate possible futures to shift our attention to potential implications of emerging technologies, and attempt to surface frictions as the starting point for debate. While these approaches differ in their methods, processes and outcomes, their aims are similar to one another. Hence, we group them as critical future-making approaches. These approaches have been employed in participatory contexts to open up debates about emerging technologies by making futures tangible (Michael 2012) especially in areas such as public engagement with science. Corporate foresight is an organizational competence that enables anticipating changes, evaluating possible futures, and orienting towards a desirable future. Corporate foresight is traditionally aimed at gaining or maintaining competitive advantage by being prepared for the future. Firms develop corporate foresight to navigate a VUCA environment: an environment that is volatile, uncertain, complex and ambiguous (Fergnani 2022, p. 821). Some management scholars argue that foresight is an organizational capability to systematically use processes to scan for trends and discontinuities that lead to change, envision multiple futures, evaluate their possible implications and triggering organizational responses (Fergnani 2022; Rohrbeck, Battistella and Huizingh 2015; Vecchiato 2015). While the primary function of corporate foresight is seen as improving firm performance, it could also help orient the organization towards grand challenges through careful engagement with multiple possible futures and more holistic understanding of potential outcomes of interventions. Foresight could help surfacing the linkages between trends and grand challenges (Ahlqvist and Kohl 2016, p. 2). However, while corporate foresight traditionally has employed elements of speculation, it often lacks criticality.

While critical future-making approaches are gaining more prominence, they remain at the margins of the design practice in technology organizations. Wong and Khovanskaya (2018) trace the use of speculative design in technology companies. They explain that concept videos often serve as speculative corporate practices, and a new wave of critical and speculative design is compatible with corporate speculation. They argue that speculative design could enable critically oriented researchers to engage with values and politics by equipping them with tactics to use familiar optics of innovation, speculation and long-term planning. However, the adoption of critical future-making approaches by technology organizations brings about new frictions. For example, a design fiction video titled "The Selfish Ledger", written by Nick Foster and David Murphy for internal use at Google garnered attention and critique when it was leaked outside the company. In the video, the narrator describes a goal-oriented ledger, which not only accumulates user data, and tracks behavior, but also nudges the users to reach a desired outcome. In the video there are several provocative questions such as: "what if we humans become custodians of data rather than owners" or "what are the implications of a ledger as an active agent who purposefully modifies our behavior?" Critical future-making approaches aim to

provoke debate, sometimes using discomfort, and invite asking questions about possible futures rather than providing answers. However, Salmon argues that when companies such as Google adopt critical and speculative design, it becomes a taunting display of power, rather than a provocation to imagine alternative futures (2018). On the other hand, Wong and Khovanksaya (2018) argue that critically oriented speculative design is highly compatible with conventional corporate speculation and re-centering criticality could help challenge dominant practices in technology design.

The future is often seen as a linear extension of the present that can be achieved solely with technoscientific advancements (Adam and Groves 2007). This techno-optimistic view of the future can blind us to the systemic and multi-faceted nature of GCs. Systemic transformation can only happen if we challenge dominant sociotechnical imaginaries and imagine alternative futures. Hence, in order to address GCs, organizations need to shift their attention to envisioning long-term futures and embrace criticality when doing so. We argue that the intersection of corporate foresight and design could provide a rich ground for fostering critical future-oriented practices to imagine futures differently.

METHODOLOGY

We investigated emerging future-oriented design practices and identified frictions that manifest during a time of organizational transition towards GCs. Our data collection was through an ethnographic study of design practices in a large multinational conglomerate company's Research and Development (R&D) Center in the USA. The first phase of data collection occurred from July to October 2019, during which Author 1 was physically present in the field. The second part of data collection lasted a total of 18 months, from October 2020 to March 2022. This second period was conducted fully remote due to the COVID-19 pandemic. The research question that guided our study was: "how are future-oriented design practices changing due to broader organizational shifts informed by grand challenges?"

The primary mode of data collection was participant observation. Author 1 conducted participant observation on a daily basis in the workspace. This involved observing day-to-day activities of designers and researchers in their organizational setting, attending weekly meetings in which team members report on the status of their work and discuss upcoming projects and project meetings of a cross-functional project. Participant observation is "a way to collect data in naturalistic settings by ethnographers who observe and/or take part in the common and uncommon activities of the people being studied" (Musante and DeWalt 2010). By being immersed in the naturalistic setting of the social groups that are being studied, the researcher takes part in the daily activities and routines of the people being studied.

Researchers' commitment to 'getting close' to the people being studied not only means having physical and social proximity, but also immersing in others' worlds grants fieldworker the access to the fluidity of others' lives, and enables an increased sensitivity to interaction and processes (Emerson, Fretz and Shaw 2011 p.3). draw on data collected through eleven qualitative interviews with key personnel in the organization. The interviews aimed at eliciting the thoughts of informants regarding the role of design in the organization, knowledge about current design practices and the overall research strategy in the organization. Informants were selected on the basis of their involvement in or familiarity with design practices, previous collaboration with the design team and their roles in the organization. We also draw on data we collected through public events such as seminars and forums the company hosted, and the company's publicly accessible publications such as journals and web pages.

FINDINGS

During our study, innovation and R&D strategy of the company was undergoing a transformation. The company had traditionally maintained a technology-driven strategy that informed its R&D strategy, but in 2014, the company decided to adopt "outside-in open innovation" in order to create value through market-driven research. Outside-in open innovation is a model of innovation that is based on collaboration with external stakeholders during the R&D, in which the company recognizes the value of external knowledge and makes use of it (Chesbrough 2014). There are several reasons for this transformation. First, by adopting outside-in innovation, the company aims to bridge the gap between technological innovation and commercial value. While some percentage of research is still being conducted in an inside-out way, in which researchers focus primarily on technological advancement and commercial applications later, the company is increasingly shifting towards starting from the challenges their customers face. An informant states that:

> "What we decided to do was to say, 'Look let's actually invert inside-out process and try to understand first, what the challenges are in the industries that we're interested in to understand what the key challenges are that our customers are facing and then start to co-create these solutions with the customers, so using their data, their expertise, but using mostly their challenges and perspectives of where they want to grow their business' … Then you want to make sure that the solution that you build that you develop actually satisfies the challenges, the requirements that we had identified with the customer, and once we've demonstrated that then we have a better, much better position to make the case, with our business units that this really can be commercially viable as a solution."

Secondly, the change in R&D strategy was a response to the increasing scale and complexity of the challenges the company seeks to address. In the opening keynote

of a virtual conference hosted by the company that was open to the public, the multinational's president lays out three main reasons for "collaborative open innovation": increasing complexity and severity of societal challenges, paradigm shift to human-centeredness, and the dissolving boundaries between production and consumption. He argues that we are going through a paradigm-shift towards human-centered technology which can only be achieved with co-creation within an ecosystem of partner companies.

Additionally, the threat being faced by the company is also a factor in the transformation of innovation strategy. This was partially due to the 'commoditization' of technologies that underpin the company's offerings. The technical superiority that drove the company's success was being matched by competitors that were offering similar products at lower prices as their once cutting-edge technologies became commodities. Thus, the company had to move away from being a product vendor, as it faced harsh competition, and towards becoming a long-term partner to customers in order to develop holistic solutions. Indeed, this orientation is promoted within the company through mottos that highlight unity and harmony, and exemplified with increasing emphasis on becoming a solution partner. The underlying premise is that the company, unlike some of its competitors, can provide comprehensive solutions that require a breadth of capabilities located across multiple functional units.

Brady, Davis and Gann (2005) state that organizations that attempt to transition into being solution providers "transform almost every aspect of the way they do business – from their business strategies and positions in the value stream, to their capabilities, organizations structures, cultures, and mindsets".

In short, these are the shifts that necessitate futures-thinking that critically engages with futures:

- Co-creation with customers
- Moving towards solution economy
- Addressing GCs

Here, we share our findings about how organizational shifts are influencing future-making practices in the design team, and identify frictions that arise due to these shifts. We find that GCs inform R&D strategies in the organization and shape the future visions they create and disseminate. Large-scale challenges such as decarbonization, urban mobility and manufacturing automation, call for changing R&D strategy to expand the scope of their offering to include comprehensive solutions to foster systems-level change rather than advancing discrete technologies. Our data points to the increasing prominence of futures-thinking and systems-thinking within the company, which reflects the increasing scale and complexity of challenges the company aims to address. We find that these shifts inform future-oriented practices of the designers and design researchers in the design team.

Expanding Corporate Foresight for Customer Engagement

Within the design team futures-thinking and foresight are increasingly being thought of as a core capacity. During the time of our study, foresight practices were already stabilized through yearly projects since 2016. The projects were broadly referred to as "Prospection", which consists of the foresight methodology, tools, and the resulting artifacts. The primary goals of "Prospection" are to assist business units with imagining future possibilities through a generative and open-ended discussion, and to facilitate future-oriented dialogue with customers. Over the years, the team has changed the tools and artifacts to adapt to changing business needs. The methodology is similar to the strategic foresight methodology that is popularized and advocated by Institute for the Future (IFTF). At the foundation of Prospection are "future signals." Future signals are subtle signs of change that hint at larger possible shifts. Signals are often thought of as the basis for foresight practice (Howard 2021), as practitioners build on these signals to identify larger patterns of change, make assumptions about possible futures and create visions and scenarios. Design team collects future signals using a template as a collective effort, and saves them to a database. Sources for these signals vary, such as news articles, blog posts, industry reports or first-hand experiences. After signals are collected, the principal social scientist begins identifying patterns and clustering these signals around topics such as governance, finance or mortality. Based on these clusters, they write short, evocative "future stories" about what that future might look like. The output of this process is usually a deck of 25-28 cards. Each card features an illustration of a scene from the future on the front, and a future story along with relevant trends on the back.

Prospection was conceived as a mode of inquiry for identifying paradigm shifts in industries and for imagining possible futures and their impact on business. There have been several projects in which the methodology and the cards were used to explore possible futures of a specific industry such as mobility, finance and manufacturing. In these projects, the design team collaborated with members from different organizational units or external stakeholders such as customers to envision future scenarios about industries that are relevant to them, speculate how these industries might change, identify future issues that might arise, and ideate on how to address them. This future-oriented approach is very different from traditional inside-out approach to methodology, as it focuses on hypothetical scenarios rather than technological capabilities. In other cases, the design team held workshops disseminate the methodology for internal stakeholders and/or train them in futures-thinking. These workshops primarily focused on teaching participants the basics of Prospection, such as collecting signs, creating future stories, and creating future scenarios, and ways to apply these methods in their own work, for example in customer engagements.

These engagements were successful in introducing stakeholders in alternative ways of thinking about the future. Prospection allowed asking "big questions", those that are pertinent to GCs such as aging population, or automation, which they may

not always have the time and space to do in their day-to-day work. Furthermore, Prospection also opens up space to engage with futures more critically, through provocative future stories that highlight widening inequality, climate cataclysm and weaponization of data.

Barriers to Adopting Futures-Thinking Across the Organization

We find that the design team experiences friction when introducing future-oriented design practices in collaboration with business units. Friction mainly arises due to the incompatibility of future-oriented design practices with the project timelines of business units. While cross-functional collaboration is encouraged by upper management as part of the innovation strategy, the barriers that hinder such collaboration are rarely addressed. To identify some of these barriers, we draw on a project led by one of the information technology (IT) focused business units. The initial project proposal, which was prepared by the business unit, highlighted that the company could be a valuable partner to the customer, as they could leverage diverse capabilities in multiple industries and develop solutions for their challenges across several domains. The business unit would play the role of orchestrator, forming work streams such as energy, maintenance or mobility and collaborate with R&D teams to propose solutions for each work stream. The design team was included in the project as they received funding from upper management to support customer engagement. Through this project, the BU aimed at cementing a long-term partnership with the customer. To the design team, building long-term partnership called for building a long-term vision, and aligning stakeholders and orienting actions around shared goals and aspirations. Therefore, this presented an exciting opportunity to showcase how design could shape customer engagement in the earlier stages by introducing futures-thinking capabilities. The design team initially focused on the energy work stream and proposed conducting trend analysis to understand driving forces of energy transitions, mapping future user expectations and experiences based on these trends and identifying opportunity spaces for developing solutions. However, as the project progressed it became apparent that proposed activities were not compatible with the established practices of the BU.

There are several reasons for the incompatibility that hindered applying future-oriented design practices in this project. Firstly, the clearly defined stages of customer engagement of business units did not allow for R&D, and more specifically the design team to seamlessly integrate into earlier stages. As R&D is seen as a cost-center to business units, hence it is not very common for business units to include R&D teams or researchers in the early stages of customer engagement, before securing the project. Secondly, the initial stages of customer engagement are seen as very delicate and fragile, and it is deemed risky to introduce new actors such as designers or design researchers to initial conversations. Finally, big visions are not deemed actionable enough and they are too abstract to make a concrete value proposition, especially for some business units that have short-term focus.

Furthermore, the future is inherently unknowable and uncertain. Thus, future-making is outside the comfort zone for business units who are more focused on solving immediate needs. It puts them in a vulnerable position as futures-thinking entails imagining alternative futures but also reflecting on present-day concerns, worries and weaknesses, which could present a risk in early-stage customer engagements.

Streamlining Future-Making: What Comes Next?

Finally, we describe how the design team is attempting to reduce friction in collaborative projects by codifying and streamlining their own practices, including future-oriented practices, and creating a shared methodology. The reasons for this are twofold. First, a methodology is seen as a way to make design practices more transparent and accessible to other teams and organizational units. As discussed in the previous examples, key stakeholders in business units are not very familiar with design and what design activities entail. Secondly, it is expected that a shared methodology would help both North American and European design teams strengthen their collaboration and integrate into each other's projects more seamlessly. In a large corporation with many design teams distributed across different organizational units, codifying design practices are seen as the solution to frictions they are facing when collaborating with different stakeholders, including business units and customers.

There is already a company-wide design-driven innovation methodology that was first introduced in 2016. This methodology, referred to in this paper as Innonext, aims to facilitate co-creation with customers, and promote social innovation for addressing GCs. This comprehensive methodology was created by codifying cumulative knowhow of designers and researchers. In an interview published on the company website, the core group behind Innonext explains that co-creation becomes more important as the challenges communities and companies face increase in complexity. While most stakeholders are familiar with the premise of the methodology, it is not always used effectively. The methodology has been used in hundreds of projects, but designers from different teams argue that it is not very actionable for business units as the vast number of tools and methods quickly become overwhelming. In 2020, the design team secured corporate funding to redesign Innonext in order to make it more actionable for business units. While the project was not completed during our data collection, we were able to gather in the initial phases of the project. The team collaborated with an external design agency to assist with developing a comprehensive framework, and collect practices under a streamlined methodology and an accompanying engagement model to collaborate with business units. The first step in the proposed methodology is "vision sharing". This entails analyzing the relevant domain, exploring business opportunities and discovering customer issues that the customer is facing. Sharing implies that both the company and the customer agree on a vision, and collaborate to achieve that vision.

However, the term "vision" takes on different meanings in the context of each organizational unit. A team member explains that for some business units, vision is limited to the scope of the specific project outcomes, while for R&D, and specifically the design team it refers to a high-level societal vision: "Vision" with a capital V. While both organizational units agree on starting with the vision, they differ in scope. This gap between different time frames and scopes for visions leads to increased friction when attempting to introduce future-oriented design practices to other organizational units.

Another friction that surfaced during the initial phases of the project was due to differing views on "codifying" design. Some team members argued that not all aspects of design could be codified, and some skills that are essential for design cannot be translated into step-by-step instructions. Furthermore, these frameworks, methodologies and tools aim to break down the "black-box" of design, and make it easy to understand and practice by non-designers. There are several assumptions that underpin the expectations from a shared methodology. A team member suggests that the main assumption is the belief that "if only we explained it enough, people would: (i) understand what we do, (ii) understand the value of design, (iii) understand how to use design…". She argues that no one asks data scientists to explain what they do, as it is assumed to be valuable, but there is a push to make design more accessible to non-designers. This is partly the result of the mass popularity of design thinking up until the 2010s. In line with the premise of design thinking that anybody can design as long as they have the right tools and follow the step-by-step process, these efforts to streamline design sometimes neglect the situated aspects of designing.

DISCUSSION

In this section, we discuss how frictions identified in the findings section are informing design team's practices and strategies. We argue that frictions enable new possibilities, as they provide opportunities to reflect on barriers and challenges.

Evolution of Future-Oriented Design Practices to Address Frictions

While the methodology of Prospection remained the same, the output changed over the years to respond to organizational needs. Here, we discuss how some of these changes are a result of the frictions identified in the previous section, but also how the team increasingly sought to incorporate criticality as a response to "frictionless futures" that are very prevalent. In 2019, the team added three new topics which are "climate cataclysm", "widening inequality", and "armed with data."

These themes were featured in what they termed as "dark cards," in which the teams call attention to societal issues exacerbated by emerging technologies. Although previous editions of Prospection cards also showcased potential implications, they were presented less explicitly and were even disguised by the cheerful and humorous illustrations on the cards. According to the social scientists in

the team, these illustrations were sometimes perceived as predictions by others in the organization instead of provocations to raise informed questions about the future. The 2020 version of Prospection was a "mural" depicting two possible futures of a city: a utopian and a dystopian future. Unlike previous editions, this mural was larger in scope as the team picked "smart city" as 2020's central theme. Instead of individual cards for categories, the city scale allowed showing how interconnected these trends are. In conversations with team members, it was brought up that the dystopian version does not look that different from today. This is an example of not only critically engaging with a possible future, but also reflecting on the present. The project description explains that tools such as Prospection help to facilitate a critical, systemic and ethical lens, and ask how to move towards a utopian future. This shift from individual cards to a mural signifies the increasing importance of recognizing interconnectedness of ecosystems to address GCs. Furthermore, by positioning two possible futures side by side, the team asks to critically examine what we mean by "smart" city.

For the 2021 edition, the topic was selected as "the New Normal", informed by the COVID-19 pandemic and the systemic issues it surfaced. While the collected signs covered the usual social, technological, environmental and political domains, they were mostly about the changes that were brought on by the pandemic. The pandemic not only influenced the content, but the engagement and dissemination model for the Prospection project. In previous years, Prospection as a method was mostly disseminated through in-person workshops for other organizational units or customers. The card deck, on the other hand, traveled across the organizational boundaries as a physical object. Shifting to remote work necessitated rethinking how to distribute Prospection for the New Normal.

This need was not only revealed by the pandemic, the integration of Prospection into existing organizational practices have already been challenging. Even within the design team, how to use Prospection was not always clear. In 2019, the design team had met to discuss a futures-thinking workshop for a business unit. While exchanging ideas about workshop activities, it was brought to surface that some team members had a different view of Prospection than others. For some, Prospection referred to the deck of cards and the cards would form the basis of activities. For others, Prospection referred to the method for inquiry about the future. Social scientists argued that the Prospection is highly context-dependent, and the value is in following the method and the process of creating future stories in a specific context. Yet, most people in the organization equated Prospection to the deck of cards, the outcome of the inquiry.

These two different views point to a bigger friction in different understandings of foresight and futures work: on one hand foresight is seen as a highly specialized technical skill possessed by the design team, and on the other hand it is considered as a broad-based capacity that is distributed across the organization. In the first view, the outcome of Prospection, as the artifact, travels across organizational boundaries

and carries "the futures-thinking knowledge" from the center to the periphery. The principal researcher argues that this expectation from Prospection is the legacy of the more traditional organizational structure, in which knowledge flows from R&D to business units. The latter view positions Prospection as a method for open-ended inquiry into possible futures, and a way to foster future-making as a capacity distributed across the organization. The challenges posed for remote work, and the friction between two differing views informed the 2021 edition of Prospection, which is titled the New Normal.

For this edition, the intended audience was selected as the salespeople in business units, in order to help them foster a future-oriented dialogue with their customers. Building dialogue has been advocated as the first step for co-creation with the company's customers. Since co-creation is considered as the leverage for transitioning to solution economy, the design team has been advocating for building effective and generative dialogue that opens up possibilities for co-creation rather than foreclosing possibilities by focusing on solutions. The format was expanded from the deck of cards to include foresight exercises and an additional workbook to help ground futures-thinking in day-to-day practices. While the process for creating individual future stories remained the same, each card included questions for the reader to engage with the content incorporating their own perspectives. The workbook section contained exercises to help the reader to reflect on their own relation to the future, and explore their customers' potential worries and hopes about the future.

Challenges and Opportunities for Cross-Functional Collaboration

While the company is aiming to foster social innovation to address GCs, techno-solutionism and short-termism is very prevalent, similar to the society at large (Byrum and Benjamin 2022). The bias towards short-term results and technological fixes to social problems were highlighted in several engagements with business units, such as the project described in the Findings section. While the design team did not reach their intended goal of supporting the business unit with customer engagement, these frictions provided a learning opportunity for them. These recent engagements with different business units highlighted the barriers and opportunities for implementing futures-oriented design practices for intra-organizational collaboration. First of all, the design team, in collaboration with their counterparts in Europe, proposed a new organizational model. Through this new model, they propose to shift towards collaborating with business units in specific industries such as rail and energy to build long-term visions. The managers of both teams argue that such business units are better suited for a joint inquiry into long-term futures, as they are focused on infrastructure-level transformation, thus they naturally operate in a longer time frame. Prior engagements with these business units in the recent years had promising outcomes. For example, in 2020, both design teams in North America and Europe were tasked with supporting a coalition of business units in several domains

such as energy and rail to prepare for a customer engagement. The prospective customer was a public body that oversees rail transport and operates rail infrastructure in a European country. The design teams focused on creating a shared vision for the future of rail. This vision helped not only to show the desired future that could be achieved through a long-term partnership, but also to align internal stakeholders around a shared goal and a narrative. In this case, the trust that has already been established between business units and design teams played an instrumental role in the project's success. Stakeholders from the business units were familiar with design teams capabilities, therefore, they were open to having them lead the future-oriented practices.

CONCLUSION

In this paper we explored the evolution in the company's innovation and R&D strategy as they increasingly orient towards solving GCs, we have uncovered a series of shifts that inform future-oriented design practices. This discussion has delved into the findings, identified frictions, and highlighted the changing practices within the design team, shedding light on the intricate relationship between organizational shifts and future-making practices. The importance of futures-thinking becomes increasingly evident in this context. As the company seeks to co-create solutions with its customers and transition towards a solution economy, and addressing grand challenges (GCs) the importance of imagining alternative futures becomes paramount. The future visions not only help orient innovation strategies, but also align stakeholders around shared goals for systemic transformation, and help reflect on the challenges already faced in the present. We found that the intersection of design and corporate foresight provides a rich ground for introducing critical future-making into the broader organization, to foster generative and open-ended discussion about possible futures. However, introducing future-oriented design practices into the broader organization is not without its challenges. Frictions emerge when attempting to integrate these practices in collaborations with other organizational units such as business units.. Nevertheless, these frictions serve as catalysts for furthering future-oriented design practices within the design team. In conclusion, this exploration of the company's journey through organizational transformation and future-making practices demonstrates the intricate interplay between strategy, innovation, and foresight. The challenges and frictions encountered provide valuable insights into the evolving landscape of corporate innovation and the pivotal role of futures-thinking in navigating complex, interconnected and large-scale challenges. As the company continues its transformation towards a more solution-oriented approach, the design team's ability to facilitate open-ended dialogue and envision alternative futures remains critical in addressing grand challenges and co-creating value with customers and partners.

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