

Opportunity Creation in Innovation Networks: INTERACTIVE REVEALING PRACTICES

Sirkka L. Jarvenpaa
Liisa Välikangas

Innovating in networks with partners that have diverse knowledge is challenging. The challenges stem from the fact that the commonly used knowledge protection mechanisms often are neither available nor suitable in early stage exploratory collaborations. This article focuses on how company participants in heterogeneous industry networks share private knowledge while protecting firm-specific appropriation. We go beyond the prevailing strategic choice perspectives to discuss interactive revealing practices that sustain joint opportunity creation in the fragile phase of early network formation. (Keywords: Innovation Management, Intellectual Property, Technology Management, Learning)

Heterogeneous networks provide opportunities for participating firms to combine diverse knowledge, escape myopia and competency traps, and expand beyond any one organization's competitive horizons.¹ Serendipitous innovation opportunities can lead to strategic renewal.²

Joint opportunities are created endogenously in heterogeneous networks.³ After a firm makes the strategic choice of participating, its researchers and engineers interact with other researchers and engineers to realize the latent opportunities.⁴ This interaction is fragile, however, during a period in which opportunities must first be identified and created before any commitment to their exploitation can be made.

A tension between opportunity co-creation and private appropriation ensues.⁵ Shared norms, social capital, and common history are largely absent early on; and legitimized, shared authorities that would penalize for emergent opportunism are still missing.⁶ Opportunity creation, and the related interaction around problems and solutions, is both tacit and murky, interfering with the commonly prescribed governance mechanisms, such as contracts, task partitioning,

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Sirkka L. Jarvenpaa is the James Bayless/Rauscher Pierce Refsnes Chair in Business Administration at the McCombs School of Business, University of Texas at Austin where she is the Director of the Center for Business, Technology, and Law. She is the co-editor in chief of the *Journal of Strategic Information Systems*. <Sirkka.jarvenpaa@mcombs.utexas.edu>

Liisa Välikangas is Professor of innovation management at Aalto University and Hanken School of Economics in Helsinki, Finland. <liisa.valikangas@aalto.fi>

modularization, and transparency.⁷ Fears of opportunistic behaviors result in parties' fleeing the scene or taking a defensive posture.⁸ Innovation opportunities fail to materialize, and networks fail.⁹

Tensions of opportunity co-creation and private appropriation are commonplace in heterogeneous innovation networks that aim to produce concepts, demonstrations, and pilots collaboratively by *integrating* knowledge across industries. Such cross-industry innovations might involve health and wellness technologies, clean energy, or the Internet of Things. Although the diversity of knowl-

edge provides the possibility of new opportunity creation that goes beyond the potential of any one firm alone, such heterogeneity demands that the participants have patience as they interact and learn from each other. In addition, the network must find its "sweet spot" in terms of the degree of heterogeneity: too little, and the commercialization space becomes crowded as firms in adjacent industries seek to profit; too much, and common ground from which firms can relate to the knowledge of others is absent or hard to find.¹⁰

Given the tension between opportunity creation and knowledge appropriation in commercial endeavors, how do network participants share enough knowledge to co-create an opportunity, but not so much that they lose their private appropriation? This situation requires firms to create the spoils before negotiating how to share them, or in the words of an experienced executive who summed up the issue: "How do you divide the bounty of the bear's fur when you've only intuited the bear's possibility but haven't sighted it yet?" The sighting requires broad effort, while the leaders in participant firms have to do the "shooting."

Revealing for Opportunity Creation

Selective revealing has emerged as a key collaboration strategy, not just in open source collaborations, which popularized the topic,¹¹ but also in the broader innovation literature that addresses situations characterized by high levels of uncertainty. Selective revealing involves sharing part of the firm's knowledge or its intentions. However, the predominant focus of such strategic revealing in the extant literature is on commercial exploitation. We extend the concept to opportunity creation.

In extant literature, selective revealing assumes a network of potential companies that respond to a focal firm's preferences; it is thus positioned as "a strategic mechanism to improve the firm's technological and market conditions" by getting others to cooperate on technology trajectories and product extensions.¹² It is commonly understood to involve voluntary spill-overs by the focal firm.¹³ Conditions calling for selective revealing include uncertainty about potential partners and a presence of competitive threats. When firms are unable to identify the right partners or define relevant knowledge, selective revealing is presented as a "clear signal of the intent to collaborate" and establishes "a common ground for collaboration to emerge."¹⁴

The process of selective revealing centers on problems and solutions. *Problem revealing* focuses on “anticipated future technological problems for which [the focal firm] seeks others’ support.”¹⁵ For example, research results might be revealed to induce complementary investments. Meanwhile, *solution revealing* discloses a solution largely embedded in “a patent, publication, or product, or product component.”¹⁶ This revelation might be undertaken to increase the downstream demand. The goal of revealing may be either path extension—for example, inviting others to enhance a particular product—or path creation—for example, by making an open research call.

The current literature positions selective revealing for opportunity exploitation. It assumes that the firm knows the technological path it wants to extend, the product extensions to create, and the markets to pursue. This perspective applies to both problem revealing and solution revealing. For example, in problem revealing, where others are invited to address a specific problem (by spreading the issue), the focal firm has (already) identified the particular issue as strategic. If the problem revealing follows the strategy of agenda shaping, the firm guides discussions and legitimate discourse toward the firm’s future preferences and encourages investments that are compatible with the technology path that the firm has already identified. In solution revealing, the product enhancement strategy extends the firm’s technology trajectories by influencing downstream demand and complementary solutions. Niche creating—a form of solution revealing—involves increasing the attractiveness of the “preferred technology trajectory” by shaping institutional rules or resources.¹⁷

However, from the perspective of opportunity creation, valuable opportunities might be missed if knowledge integration is constrained by previously predetermined and already committed problems and solutions. Therefore, heterogeneous networks have an important role to play in supporting novel opportunity creation beyond existing horizons.¹⁸ The very heterogeneity invites the harnessing of the participant knowledge and exploration of its many recombinations. Rather than simply revealing a predefined problem, a heterogeneous network may engage in problem abstraction and its distancing. For example, what would be a global expression of a local problem, such as water shortages? Rather than seeking agreement or collusion on one solution, a heterogeneous network might solicit multiple perspectives and technological approaches. For example, oil companies have learned from the cement industry how to keep oil liquid in arctic conditions in case of an oil spill.¹⁹ Or a forestry industry company collaborated with a professional college to develop an environmentally friendly concept car.²⁰ Because opportunity creation may be oriented toward path creation that goes beyond the problems and/or solutions conceived thus far, we propose a third revealing strategy—*context interacting*—which is about shifting the conversation from a particular point in time to the future, or from a particular business model to a broader set of novel competences, or from a specific industry focus to seemingly remote innovation arenas where similar functional challenges exist. Table 1 summarizes selective revealing strategies for opportunity exploitation and opportunity creation.

Revealing for opportunity creation poses novel challenges for knowledge protection beyond mechanisms targeted at exploitation. Market power strategies,

TABLE 1. Selective Revealing in Opportunity Exploitation and Opportunity Creation

Opportunity Exploitation*	Opportunity Creation
<i>Problem revealing:</i> Issue spreading; Agenda shaping	<i>Problem interacting:</i> Distancing and abstracting to open up the problem definition
<i>Solution revealing:</i> Product enhancing; Niche creating	<i>Solution interacting:</i> Addressing the issue from multiple perspectives and knowledge bases
	<i>Context interacting:</i> Exploring open-ended novel business trajectories and future visions

*O. Alexy, G. George, and A.J. Salter, "Cui Bono? The Selective Revealing of Knowledge and Its Implications for Innovative Activity," *Academy of Management Review*, 38/2 (April 2013): 282.

such as a dominant design, rely on problem definition by a leading firm and eliminate joint opportunity creation. Strategies for knowledge modularization or information trading of segmented knowledge along commercial or expertise domains reduce costly conflicts in exploitation but simultaneously prevent unexpected and serendipitous knowledge (re)combinations. The exercise of legal privileges (e.g., patents, trade secrets) narrows collaboration and again restricts combinatorial possibilities. Also, separating knowledge from its data source or revealing only partial information requires collaborators to procure the remaining knowledge from other sources.²¹ These practices delay collaboration and suppress serendipitous, integrative opportunity creation. Some studies²² have acknowledged that in early R&D collaborations, participants face a "paradox of disclosure," wherein either too much or too little sharing threatens to end the collaboration. Yet these studies do not provide remedies beyond limiting collaborations to trusted relationships.

There is a need to better understand strategic revealing in opportunity creation. In particular, practices in opportunity creation need to be identified that extend beyond internal and bilateral R&D teams²³ and beyond the interactions between industrial and academic researchers.²⁴ Although researcher interaction among current and potential competitors is not a new problem, it has become more salient with the increasing popularity of heterogeneous innovation networks. We next describe a study of how heterogeneous network participants learned interactive revealing for opportunity creation. Problems and opportunities were neither formulated by any one firm prior to the engagement nor defined by focal firm broadcasting. Rather, new contexts were jointly explored and improvised through novel and spontaneous opportunity creation, and participants learned about problems and solutions through trial and error. These interactive revealing practices emphasize both what is revealed and how it is simultaneously protected. The process encompasses not only what to reveal but importantly, *how to reveal*. In such interactions, participants co-opt some of the strategic choice from their managers.²⁵

Research Context

The hundreds of industrial participants we studied were participating in four different innovation networks in Finland. The networks comprised varying industry segments, including information and communication technology (ICT), forestry,

metal products, and energy. The networks were founded in 2007–2008. The research programs in each network varied greatly in their very broad goals, including doubling the value of the member companies in the next 25 years, developing new business ecosystems, and developing globally competitive capabilities in new markets, such as clean energy and digital services (see Appendix). Global competition created a sense of urgency among the member companies as they actively sought new growth opportunities. Each program was led by an industry representative. The reasons for joining the networks were highly varied, apart from competitive pressures, and ranged from curiosity to product development motives, to eventual interest in exploring new knowledge domains and ecosystems.

Each network managed 4 to 6 large research programs, with up to 60 participating organizations and up to 500 participants. Industrial organizations—including both large and small companies—self-selected to join the network. University and national research laboratories participated at the request of an industrial organization. Funding, which reached into the hundreds of millions of U.S. dollars per constellation over the first four years, came from the participating companies (50% or more), with the balance provided by a public innovation agency.

We observed and interviewed participants in the research programs during the first four years of the networks' existence. We interviewed over 100 people, some multiple times, with participants and project managers (see Appendix). For a balanced view, we also interviewed managers, senior executives of the organizations, and the network leaders. Additional data came from archival and public sources, industry reports, Web material, and internal research documents, as well as participation in all-hands research meetings.²⁶ We were able to study the research networks in real time as they formed and had broad access to various constituents.

For most firms and their participants, the networks represented a far broader based collaboration than they were accustomed to and one for which they had no proven practices. Not surprisingly, nearly half of the early programs ended prematurely or experienced the departure of key partners, thus suggesting some degree of failure early on. However, the four networks all continue to function, even six and seven years later. Recently, an external assessment by a group of appointed leaders made recommendations that primarily addressed the administrative process. Public funding has continued, and the networks compete for their funding. The public funder has collected data at the aggregate level in terms of patents, publications, and pilot studies, and based on this data, the continued public funding has been seen as justified. The networks have continued to attract more companies that wanted to participate than could be accommodated, and they have developed many across-network research programs, thus further increasing their heterogeneity. One of the networks has been reformed to increase the heterogeneity of its membership. Generally, participants appreciate that the networks represent and provide a novel way to collaborate across industry and academia for future innovation potential. The networks have also made significant progress in connecting internationally.

In our research over multiple years, data collection and analysis were intertwined. We wrote narratives of each network with key events, concerns, and developments. Multiple rounds of coding were conducted around sharing and protecting

that involved note-taking, memo-writing, and open coding, throughout which we immersed ourselves in the data and began to examine the revealing practices. Using an iterative process, we mapped the instances of practices to different categories, and the categories that ultimately emerged are presented in this article.²⁷ We also followed an iterative process of visiting theory, data, and literature to refine our findings, ground them in theories, and clarify our contributions.

More specifically, we followed the Gioia method²⁸ of inductive sensemaking based on grounded theory research. In the interviews, we sought to capture and then interpret interviewee meanings and organize them in a “data structure” of progressive abstraction that consisted of interview quotes, then the emergent themes—in particular, protecting and revealing—and then their aggregate concepts.²⁹ For example, a phrase in an interview, “look at the problem as if from afar,” was linked to a focal issue of sharing generic issues while protecting specific company core issues. This phrase was then related to a higher abstract concept of “Interacting around problems.” A quote that referred to “forcing people to work together to get meaningful results in three months” helped us to delve deeper and discover how researchers, while working closely and sharing results, frequently did not share methods. This theme led to an aggregate concept of “Interacting around solutions.” The quote, “no need to reveal what a company will (wish to) do with the results,” disassociated the context of research from a firm’s future intentions. The quotes around this theme were mapped to the aggregate concept of “Interacting around contexts.” We built on a theoretical foundation of selective revealing and grounded the emergence of practices in a narrative.

The two authors took different roles in different phases of the analysis. The first author conducted most of the early interviews; the second author participated in later ones. The analysis was conducted independently by both and then intensively discussed. To improve the validity of our findings, the results of the initial analysis were shared with the key informants and were presented to a number of audiences participating in the networks. One senior executive told us that the results, or the selective revealing practices we identified, “capture explicitly what has been happening,” although he “was not able to articulate them before.” The final set of revealing practices was validated with six key network leaders.

The Networks in Formation

First, research contract negotiations stymied progress. Much bickering arose over the pricing of research deliverables, over the transfer of the innovations to different parties, and particularly over who would have access to the results. A public sharing rule was then instituted by the technology and innovation agency that mandated the following: a free user-right to all research results (i.e., foreground material) for those participating in the research program, without any exceptions or consideration of the amount of private investment; licensing of all knowledge brought in to the project (i.e., background material) to all participants, either for free or for a reasonable fee; and making the final results public. The rule was intended to eliminate the time-consuming determination of the value of an innovation that did not exist or could not yet be materially conceived. The rule also preempted prior collaboration

modes that, by segmenting knowledge, reduced the potential for opportunity creation. The industrial participants were unable, or at least less able, to use these familiar modularization strategies, as well as bilateral contracts and exclusive licensing and patenting arrangements.

This public sharing rule was contested by participating companies, causing emotional backlash and interfering with the collaboration while frustrating the participants who struggled with different research traditions and cultures. Some industrial participants were told by their firms to limit their research interactions to already familiar and trusted parties, undermining the premise and purpose of heterogeneous network innovation. Even as the tension of value appropriation was dominating conversations, however, so, too, did the urgency to co-develop innovations and expand the collective opportunity space. Many managers of the participants acknowledged that a bigger overall pie had to be created and different kinds of expertise pooled: “The required resources are so large that no single firm will be able to go alone,” nor does a firm alone have “the aspiration levels necessary”; collaboration was about “new market creation,” and “new horizons” would be developed in the partner network. One company executive reflected on the early challenges as follows:

“The company must change its internal way of operating to benefit from the collaboration. Not just think about product development in a narrow sense but about new competitive arenas and breakthrough goals....We are trying to come to terms with new phenomena, such as Cloud or Clean technologies, that require partnering with others to sketch the big opportunity picture. We try to match research institute competences with company needs and understand what is business-critical among the new emerging themes....Important to success is a participant company that is able to run with the emerging results—not just consultants innovating but industrial companies implementing.”

Transitioning to Interactive Revealing

Participants joined with little awareness of how the networks would require knowledge-sharing practices different from those to which they were accustomed in internal or bilateral R&D teams. Some participants continued to rely on private contracts and case-by-case settlements. For instance, one large company initially required its participants to sign separate nondisclosure agreements (NDAs) with partners, thus complicating knowledge sharing in the research programs. This requirement reduced the research to bilateral collaboration, which not only was unacceptable to the public funder, but also interfered with opportunity creation in heterogeneous networks. Another incumbent company used an arm’s-length strategy and hired a small consultancy company as its legally valid representative to represent the firm in various project meetings and joint project actions. However, this one-man company representative did not possess any of the client expertise and competences of value and interest to others in the project. Other firms hid behind academic participants.

To move forward, the companies needed to find middle ground between “sitting on the defensive” (not revealing anything) and “risking our core technologies getting licensed for free” (revealing too much). Sitting on the fence took the participants out of the interaction and away from collaborative opportunities: “You learn

that to benefit, you have to share.” However, participants were also cautioned by their leaders and legal counsels to not give away the crown jewels. Soon there was a realization that new practices had to be developed. These practices required a strategy that did not simply rely on knowledge exclusion. The first step was to play a “game of knowledge trading” in background information. One network leader shared his observations in the programs he oversaw:

“Now we exchange background information in research program preparations. This behavior is new. It’s like ‘we bring new information A and you bring new information B, and then we evaluate which one is valuable,’ and so on.”

Knowledge trading did not necessarily move the related research from familiar and safe terrains toward novel opportunity frontiers and was eventually rejected as a *modus operandi*. Other participants practiced defensive strategies. One strategy meant that particular knowledge had to be circulated through parties that were known to be laggards in forwarding details. Another strategy involved writing reports in the local language (Finnish), which limited diffusion in companies with international workforces. Some participants at times simply identified the background facts as available, and anyone interested in seeing them had to make an explicit request to gain access to the content. Then, in response, the content would be provided piecemeal, in different releases or versions. Such delaying tactics tended to harm not only the joint collaboration but also the firm’s interests because other partners were likely to reciprocate with similar actions, slowing down their contributions and adversely affecting the overall progress. Not speaking out, or non-revealing, was also acknowledged as useful by a leader:

“At the network level, we have a practice in place that if you do not want certain information to be part of background or foreground, do not bring it up.”

Although some shirking and opportunism remained, most participants began to realize that a new mindset was critical for realizing the potential for opportunity co-creation. As one company’s legal counsel put it:

“I first thought that there are only two extremes—the closed innovation mode and the open source mode. But now I realize that [our joint work] is about that gray stuff in the middle. That middle is up to us to define and come up with the playbook.”

The participants eventually learned to practice revealing in a way more suited to joint opportunity creation. The following sections explain the practices as revealed by our research.

Problem Interacting While Protecting Context

The first set of practices focuses on interacting around problem areas while protecting by abstracting and therefore obscuring the strategic context in which the problem (or problem area) is critical for the company. As one executive noted:

“It is essential to differentiate between generic issues (to be openly discussed) and those that belong to our core business (to be protected).”

For example, the discussion might focus on the improvements in user interfaces but not on what design a particular company considers strategic for its customer retention; or green energy systems offered a way to discuss too high CO₂ emissions,

but left hidden where the firm faced difficulty in meeting the environmental standard. In this realm, academic participants were helpful in terms of separating the general or common from the contextual and of serving as conduits for the diffusion and travel of research ideas. The practice helped protect private interests because the firms did not share the nature of their particular technology or business handicap.

Another related strategy that allowed for revealing problems while protecting context was distancing. One participant noted that sharing particular information was a sensitive move, but when looked at from afar, “as if from outside,” its meaning was relatively minor; hence, the sharing, which was critical for moving forward at the time, became possible. Also, some participants achieved distance by deliberately taking a very long temporal perspective. Such distancing helped them to develop a reflective perspective, rather than focusing on the issues, and even emotions, at hand. In some instances, we observed that distancing involved stepping outside an in-company role for the sake of aligning multiple interests and thus opening the door for in-the-moment compromises, as the needs indicated. For example, one participant noted that the development of a new kind of nanoparticle was important for a number of firms involved: One stainless steel firm might apply the particle to increase the versatility of its steel, while an engineering firm might support its solutions-oriented business. Thus, everyone benefitted, and “that was ok.”

Humor was also used for distancing in the form of scripted plays—part of an informal workshop that made fun of entrenched participant roles and hence opened up possibilities for less guarded interactions. In a number of ideation sessions organized in one research program, a senior industry executive acted as a jester to poke fun at the industry dogma. Such humorous distancing helped participants to establish a detached perspective to their businesses, allowing them to share knowledge on sensitive or embarrassing issues (for example, about prior firm failures). Humor helped to get over bottlenecks or tough situations, in cases where determining what to share and what not to share seemed challenging to impossible, or where sharing sensitive information had to happen to avoid unproductive directions or make any progress at all. The speaker was allowed a stance where revealing more than usual was permissible. In addition, through such practices, participants benefited from the fresh perspectives that wit allowed, which helped them to change the framing of an issue in terms of varying contexts, time horizons, or playfulness. Participants were then able to be more nuanced (and perhaps less embarrassed) in revealing problems areas.

Box 1. Practices for Problem Interacting While Protecting the Company Context

Abstraction: Discussing research issues at a sufficiently high problem level, with the support of academic participants, to mask any one company's strategy context. For example, discussing attractive user interfaces at the

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design level while not disclosing the company's lack of customer retention; or while protecting the company's particular business model, sharing lessons learned regarding existing effective business models in a particular technology area.

Distancing over Time: Assessing the likely competitive significance of particular information over the long term. For example, “stepping outside the company view” to see the communications, payment, and interface infrastructures required for digital business—and to appreciate the eventual benefits for the company, thus facilitating the company's contribution (or sacrifice) to building such an infrastructure.

Distancing with Playfulness: Scripting and acting out roles that showcase behaviors that help reveal and protect skillfully. For example, acting out a role-play where nothing is shared and one where far too much is revealed, thus exposing industry dogma with humor.

Challenges certainly emerged in interacting around problems. Separating the problem and the company context required a certain level of unfamiliarity. In some collaborations where the parties had a long shared history, masking knowledge was impossible because the strategic context was shared. In these cases, the network lacked heterogeneity. The particular network later reformed, with much greater participant diversity. If too many parties were involved in the collaboration, with some leaving and others constantly entering, sharing was meaningless because knowledge did not accumulate, and joint opportunity creation was not productive. Research programs that were too fragmented experienced early termination.

Solutions Interacting While Protecting Intent

The second set of participant practices focused on interacting around solutions while protecting company strategic intent. Thus, the joint activities focused less on one firm's seeking other firms that would follow its lead and more on aligning for joint exploration—and hence path creation—of possible future solutions. Although focal firm signaling did take place—for example, cloud technologies were a key future growth area for one participant, which sought to persuade other firms to join in application development—more often, firms interacted to explore a solution path and keep the momentum going. In exploring future solutions (e.g., novel ecosystems capable of providing seamless services), protecting firm strategic intent was important because firms had to be able to differentiate their future offerings and avoid losing bargaining power over competitive positioning and partnering. This key aspect was emphasized by a network leader:

“We attempt to provide a generic work flow and tools for the development of digital services and try to advance the collaboration between various parties in the [network] context without requiring that the involved parties reveal their real strategic intents.”

Solution interacting required the alignment of participant research activities. Initially, one research program adapted parts of an agile software development

methodology³⁰ to coordinate research interactions that involved business model, organizational model, and large-scale platform development. In this large research program with over 400 participants, industrial and academic participants worked together in short three-month sprints to accomplish tasks while committing to regular interaction. The practice established an expectation of regularity in joint work. Smaller tasks lowered the threshold of engagement, while the results brought participants together at regular intervals. Participant attention was allotted to the completion of tasks rather than to the (strategic) significance of tasks themselves, while the working method enabled participants to get to know each other and practice carrying out research together.

The progress in such sprints was attributed to “forcing people to work together to get meaningful results in three months, by clarifying and aligning goals while making research more iterative,” according to one researcher. The regularity legitimated a structure in which the participants could work and thus eased interactions while suppressing discussion on the competitive significance of the emerging solutions. An emergent prototype might be based on “a case study at the customer site,” but the customer was not revealed (particularly the line of business of the customer). Only the results related to the testing of the prototype were described. The underlying methods to generate the results were not shared. The standard templates for a poster-type of sharing provided legitimacy for not revealing sensitive aspects, such as methods or company goals. After the research program demonstrated the successful use of sprints, the practice was adopted by other research programs.

Box 2. Practices for Solutions Interacting While Protecting Intent

Aligning activities over time: Breaking work into tasks to be reported at regular meeting points. For example, industry and academic researchers engaging in sprints (short task sequences) to accomplish narrowly defined tasks at a rapid tempo, meeting every two to three months to present and discuss posters communicating recent results.

Focusing on process, not strategy: Protecting private interests while moving research ahead on process grounds. For example, a number of companies, including competitors, participating in cloud platform development using an agile methodology.

Engaging in such coordinated, fast-paced activity was not without its challenges, of course. Agile methodology, even when modified to fit the research context, was a practice that conflicted with the logics both in industry and in academia. Many participants from industry firms were not used to abiding by a mandate to work jointly with other industry and academia partners. Working alone or just with academic participants on a sprint was not permitted. The participants were not accustomed to producing and disclosing something every three months. Neither was academia used to three-month research cycles: “We cannot make systematic and reliable research within three months.” Sprints also went

against the logic that outcomes had to match plans. Only goals and outcomes were specified in plans, rather than methods and teams, and this level of unstructuredness was uncomfortable to some: “I need to know whom I report to.” Nevertheless, the sprints forced people to work together in temporal alignment along a particular solution path while increasing research interaction substantially. Sprints helped to make the potential solution path visible.

Context Interacting While Protecting Problems and/or Solutions

The third interactive revealing practice, interacting around contexts, is about sharing an experimental platform or the general business case while not revealing the specific problems or solutions of interest to the firm. Innovation sessions, pilots, and testbeds in experimental contexts removed from the firm’s current business were frequently used in combination as tests of research concepts for their business viability.

Heterogeneity of firms was highly valuable in providing different knowledge and competencies and allowing firms to play different roles. One participant suggested that good pilots require know-how from different companies. Such broader knowledge expanded the capacity to envision a new landscape. The joint team would define the requirements for a broad concept test, such as environmental monitoring; it would then set up separate field pilots that would fulfill these requirements. Such field pilots might focus on natural monitoring sources and remote sensing technologies. Simultaneously, some team members worked on the basic research issues, developing an overall testing capacity and general environmental efficiency assessment. Sharing results was meaningful because of the jointly envisioned landscape of domains and trajectories for environmental monitoring. There was no need to expose a preferred technological or commercial path, business strategy-related motive, or solution embedded in a proprietary platform. The practice required participants to reveal the results of a particular experiment that added detail or expanded the emerging landscape, but it did not require that they reveal the results’ technological or strategic significance to the company. As one research leader expressed the matter:

“No need to reveal what a company will (wish to) do with the results. Thus, your company strategy can remain protected.”

Revealing in experimental contexts offered a neutral ground on which to engage, including in innovation labs, scenarios, and business cases. Sharing results (even when they failed) was easier when participants were not situated in the current or a near-term business setting. Representational forms, such as business or user cases, provided grounds on which to discuss the value of accumulated knowledge and to integrate the different pieces of knowledge into a more narrative or meaningful picture. Such accumulation was possible even when in the nascent landscape the technology or user roadmaps were still sketchy or deficient. These representational forms allowed for “telescoping” to the future, leveraging heterogeneous knowledge in the networks.³¹ Thus, each company could reflect on its competences against jointly revealed future prospects while protecting its technology development. For example, an industrial equipment firm explored the opportunities of carbon fiber by watching other participant companies experiment in the

emerging area without knowing their future intent nor the details of how their results were generated.

Box 3. Practices for Context Interacting While Protecting Problems and/or Solutions

Taking research into an experimental, external context: Sharing results in innovation labs, testbeds, pilots, and experiments while detached from the firm's current and future strategy. For example, participation by a leading company in a number of different monitoring pilots across research projects, providing its measurement competence and combining it with non-incumbent companies' potentially novel ideas to address environmental monitoring. (The company had initially refused to participate, thinking it was more advanced than the other participants, but soon realized that the project had already reached the state-of-the-art methods that the company had mastered.)

Developing neutral platforms: Developing joint platforms and tools outside firm context. For example: FORGE Service Lab; idea generation workshops; startup environments; hackathons; and discussing extraneous business cases.

Outside platforms played an important role. One such platform was the FORGE Service Lab,³² which supports the development of digital services in private and public sectors. FORGE was developed in one of the networks as a response to an explicit need to identify and experiment on capabilities for designing and developing digital services. It also provides shared telecommunications infrastructure. The university startup environments provided another neutral ground to engage in idea work³³ around emerging technologies and to discuss business cases, such as in gaming and health and wellness. Still other platforms included rapid idea generation workshops around various uses of wood, which developed hundreds of ideas to expand into new customer segments, from industrial to consumer and from paper to textiles. The one-day workshop became a sort of social platform where teams competed on the number of ideas they could produce. The winning team generated more than 600 ideas. Such platforms or events—including “hackathons,” which were joint development events over a weekend—allowed participants to assess future perspectives without revealing future commitments and to keep firm competences and strategy private. Their generic nature promoted the development of capabilities for fast action without disclosing the underlying methods or planned or intended development paths.

Even when a neutral context was sought, there were challenges in executing the practice. Shared contexts built on some elements that contained private company knowledge or assets. The fear emerged that a particular firm's technology would be licensed for free in the form of an experimental platform. This legal exposure was a concern to the firm's managers. The researchers soon learned to separate and in part manipulate what was made accessible for use and what remained private by using different terms. Rather than calling certain technology assets “background,” which implied that the knowledge would be shared among network participants,

TABLE 2. Results: Interactive Revealing Practices in Joint Opportunity Creation

	Interacting around Problems	Interacting around Solutions	Interacting around Contexts
Protect:	Company Context (by abstracting and distancing)	Strategic Intent	Problem/Solution (and the company strategy)
Reveal:	Problem Area	Emergent Solution or Solution Path (by temporally and methodically aligning tasks and development paths through disciplined interactions)	Exploratory Context (by engaging in experimental acts that combine into potential landscapes and trajectories for the future)

the term “platform” was used to imply proprietary technology assets. Another challenge arose when firms used business cases as a smokescreen, presenting case details as mere formalities rather than incorporating any real business thinking. Over time, the programs developed many generic tools and practices, such as poster templates and collaboration maps that allowed the firms to work together without revealing private problem issues or solution methodologies.

Table 2 summarizes our discussion of interactive revealing in pursuit of joint opportunity creation. In “Interacting around Problems,” the company context is protected; in “Interacting around Solutions,” its strategic intent is protected; and in “Interacting around Contexts,” the problem—the company’s technological interest—and its preferred solution, such as a particular trajectory to be followed in the development of an offering, can remain hidden while different landscapes for the future are envisioned and jointly explored.

Note that the actual practices in each of the categories evolved based on participant engagement. The particular practices we observed are merely illustrative of the art of interactive revealing in joint opportunity creation. Additional ways of sharing and protecting knowledge may have been so creative as to be almost unobservable in their finesse.

Although the networks we studied were located in Finland, and partial public funding was used to incentivize university/industry and cross-industry collaboration, similar research environments are found in other countries.³⁴ Many researchers have underscored the need for frequent interaction yet acknowledged its tension of co-creation and appropriation.³⁵ Our study’s contribution is to advance practices for coping with the tension.

The Contingency of Heterogeneity

The heterogeneity in the networks influenced interactive revealing. On the one hand, too little heterogeneity stymied the revealing because all company contexts were essentially the same. One network experienced intense industry rivalry because of too little heterogeneity. Revealing anything at all exposed the company’s strategic intent. Nor was it possible to discuss problems or solutions at any level of abstraction or distancing. Thus, the principle of protecting while revealing was not

available, and the constellation eventually reformed to include more heterogeneity in its membership.

On the other hand, too much heterogeneity deprived the participants of any common ground for discussion, and any knowledge revealed was meaningless to others. Very little knowledge integration was accomplished. This excessive heterogeneity happened on one occasion when many small companies joined a network with a variety of interests. Moderate heterogeneity was most conducive to joint opportunity creation. The diversity was enough to allow for protection of revealed knowledge, yet it also evoked joint opportunity creation. Three of the networks were able to move toward moderate heterogeneity (see Table 3). Moderate heterogeneity appeared to facilitate conditions for finding the “sweet spot” wherein participants were able to use the interactive revealing practices.

At the participant level, heterogeneity is demanding. Creating something new, beyond what any one firm can accomplish alone, requires a mentality that is elastic enough to appreciate the value of larger, heterogeneous collaboration for long enough to produce interesting research results that then, after they emerge, can be moved inside the company for commercialization. As a network manager stated:

“The Achilles’ heel is that without joint value creation, there is no capture of value either. Firms have to be able to assign a participant to a project who is able to contribute but also to bring the value back home.”

Such participant capability requires an appreciation for a multitude of competences and a pooling of expertise—as well as an ability to deal with occasionally high levels of frustration, as our participants testified: One has to be comfortable with the “fog of the future,” outcome ambiguity, and different time horizons, for example. Participants also must be alert to serendipitous developments to identify the potential they offer for innovation. Clearly, much is expected from the participants who are engaged in projects, despite their spending only limited time on any one project. Without attentive participation, at times in what seemed like “endless meetings and gatherings,” the participants lost out in the integration of results, particularly across different research programs. The researchers’ persistent participation, or their absence, in the program and its meetings affected the knowledge combinations they could bring back to their firms for appropriation.

TABLE 3. The Four Networks in Comparative Terms and the Nature of Heterogeneity

	FIBIC Forest Cluster Ltd <http://fibic.fi/ shok>	Digile (formerly Tivit Ltd) <www.digile.fi>	Fimecc Ltd <www.fimecc. com>	Cleen Ltd <www.cleen.fi/ en>
Knowledge Diversity	Low	Medium to High	Medium	High
Rivalry	High	Medium	Low	Low
Nature of Heterogeneity	Low	Between High and Moderate	Moderate	Moderate to High

In a heterogeneous network, the interactive practices we have identified go beyond the trading of knowledge and the “buddy” models of sharing knowledge with trusted partners. Sharing knowledge with the trusted partners may indeed be safe; however, it substantially limited exploration beyond adjacent issues. Because of the large number of participants, the heterogeneity served more as a catalyst than as a risk mitigation *strategy*, as illustrated in the literature:

In these kinds of collaborative endeavours, each partner is afraid that sharing ideas might enable another partner to patent knowledge, which is of a competitive nature. Each partner has its own ongoing business activities and each partner is concerned about the possibility that another partner gets the opportunity to disturb these existing business activities....[Therefore], we explicitly defined for each partner its own domain of expertise. [The alliance manager]³⁶

Even without the public sharing rule, the networks simply included too many participants for any divide-and-own agreement. Pilot studies, or experimental research prototypes, were acknowledged to require competences from many firms to accomplish something novel. Research in an area like nanotechnology was applied for steel and for paper production. Importantly, the nature of heterogeneity that proved to be valuable could not be judged ahead of the collaboration (thus complicating its use for risk mitigation) but could only be understood afterwards when the opportunity emerged. If the firms in our study had decided that nanotechnology research was owned by the paper firm in a divide-and-own agreement, the steel company would not have learned about the advances, nor could it have applied the results in its different commercial domain because the results would have been patented by the paper firm conducting the research. The outcome validates the call by the executive already cited in our introduction to “divide the bear fur later.” In addition to its recombinatorial purposes, heterogeneity was used for building experimental platforms where different companies could choose to play different roles. One such outcome was the already mentioned FORGE Service Lab, offering support infrastructure and tools for companies interested in developing digital services.

For the opportunity areas to emerge, firms had to provide different building blocks. New opportunities required bringing together a number of different interfaces, infrastructures, and transactional competences. Researchers of energy and environmental sustainability came together for “clean” energy with vastly different value and belief systems. Participants in research programs on health care and digital services explored new landscapes around “speedy recovery.” In these ways, heterogeneity was harnessed for framing, exploring, and developing large opportunities, where novel customer offerings and value claims could be made by multiple firms, some of which competed with each other and some of which were supportive of, or complementary to, each other, thus constituting a thematic ecosystem. In these emerging opportunity areas, firms could participate while keeping their strategic intents hidden.

Implications for Network Leadership

These practices do not eliminate the need for the participating firms and their leadership to make strategic choices. To the extent that firms decide to engage in joint opportunity creation, rather than broadcast their technological position to

the network “out there,”³⁷ the interactive revealing practices gain urgency and importance. While the managerial literature has previously discussed activities such as distancing or pilots for different strategic goals, these activities have not been considered as part of interactive revealing, although they generally are acknowledged to be constitutive of opportunity creation. We found interactive revealing naturally embedded in these exploratory elements.

Interactive revealing allows collaborations without pre-existing relationships. Without the burden of the past (and possibly also of the future in terms of strategic commitments), network heterogeneity can be used to fuel innovation. Interactive practices then allow for the competing options to be explored, without their being limited to, or imprisoned by, judgments based on the leading knowledge and superior appropriation capabilities of industry incumbents. Smaller participant companies reported having doubled or tripled their earnings during the seven years of our study, whereas larger incumbents pointed to learning strategy-critical information. During the external assessment of the network conducted by an independent consulting company, many senior executives expressed satisfaction with the collaborative model. The executives publicly suggested that the network represented a “novel way of collaborating for the future due to its heterogeneous constitution and researcher interaction.” Some thought the network was a good way to rehearse such broad collaboration—a critical capability for the future of their company’s competitiveness. One senior industry executive described the value of the network as lifting the business’s aspirations:

“Where we have looked into the future more carefully and collaborated in new kinds of ecosystems and value chains, we are already up and running and much better at coping with opportunities as they emerge.”

The challenge for the leadership is to realize that interactive revealing supports a nuanced approach, in which knowledge that is constitutive of opportunity creation can be revealed in a skillful form by abstraction or distancing, while the knowledge that is crucial for value appropriation can be simultaneously protected. Certain knowledge, including intent, can remain private, but the ways in which the problems and solutions are represented likely differ when considered in light of creating opportunities vs. appropriating value. Hence, the practices suggest a difference between the pieces of knowledge that firms create an opportunity with and the pieces they need to appropriate value from.³⁸

Conclusion

While interactive revealing is no panacea, and is not presented here as a singular innovation model, it nevertheless is fit for creating non-adjacent opportunities that require integrating knowledge into new opportunity arenas. The approach goes beyond seeking partners to solve existing technological issues or developing commercial capacity for product-market exploitation. In this particular application, heterogeneous networks and their diverse knowledge create more expansive opportunities for researchers who can engage in network leadership by abstracting knowledge, distancing the context, and working in alignment to reveal and combine results into larger visions—all without leaking company development intent and proprietary methods.

Malcolm Gladwell tells an illuminating story, “The Bakeoff,”³⁹ about a competition to create the world’s most nutritious yet delicious cookie. The winner was the team that excelled in knowledge integration: “The decisive edge had come not from the collective wisdom of a large group but from one person’s ability to make a lateral connection between two previously unconnected objects: a tortilla chip and a cookie.” Interactive revealing practices can increase the integration of diverse knowledge without relying on a single person’s genius, while reaching beyond open sourcing or modularizing knowledge in a pre-packaged form. Who (else) might have guessed—ahead of the bake-off—that tortilla chips would be the winner when combined with cookies?

APPENDIX

The Four Heterogeneous Networks in the Study

	FIBIC Forest Cluster Ltd. < http://fibic.fi/shok >	Digile (formerly Tivit Ltd.) < www.digile.fi >	Fimecc Ltd. < www.fimecc.com >	Cleen Ltd. < www.cleen.fi/en/ >
Core Industries	Pulp and paper production, wood products	Information and communication technology (ICT) device manufacturers, software, telecom services, content	Raw materials, metal products, engineering services, machinery and vehicles, marine technologies	Energy and fuel production and distribution, water maintenance, waste management and recycling
Purpose	To double the value of forest industry products and industry from 2006 to 2030/	To create ICT-based business ecosystems to enable new global growth business/	To create new international research networks, new top science, and new application-driven research contents/	To leverage the Finnish competitiveness in global energy and environmental markets/
Research Programs (during the first four years)	Intelligent and resource-efficient production technologies (3 programs), future biorefinery, customer solutions for the future	Future Internet, flexible services, device and interoperability, cooperative traffic, cloud software, next media	Breakthrough materials, intelligent solutions, global networks, user experience, service business	Smart grids and energy markets, future combustion engine power plant, measurement, monitoring, and environmental assessment, carbon capture and storage program, efficient energy use, distributed energy systems
SHOK-Specific Semi-Structured Interviews (many people interviewed multiple times)	Executive/Sr. Leader (13), project mgmt. (11), Researcher (10)	Executive/Sr. Leader (15), project mgmt. (18), Researcher (17)	Executive/Sr. Leader (12), project mgmt. (10), Researcher (13)	Executive/Sr. Leader (11), project mgmt. (10), Researcher (9)

Other Data Collection Methods	Participation in workshops, annual conferences, documents and archives (including legal contracts), informal conversations	Participation in workshops, research program seminars, foresight seminars, archives (including legal contracts), informal conversations	Participation in annual seminars, program launch seminars, archives (including legal contracts), informal conversations	Informal conversations, archives (including legal contracts)
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Notes

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18. Such an exploitation focus may dominate even in heterogeneous networks if a single firm or agency controls decisions or has undue influence. A dominant firm may use its predetermined problems and solutions to lock the rest of the network into a particular competitive situation, which would limit the ability to benefit from exploring and traversing alternative technological paths with other organizations that offer differing knowledge, competencies, and aspirations. Although a firm is likely to enter a network with some strategic intentions, shaping these intents within the firm is as much of an objective as shaping the intents of others.
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