Using a supermind to design a supermind: A case study of university researchers and corporate executives co-designing an innovative healthcare concept

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Abstract

In 2019-2020, the Collective Intelligence Design Lab (CIDL), an initiative of the MIT Center for Collective Intelligence (CCI), worked jointly with Takeda Pharmaceutical's Center for Scientific Leadership and Innovation (CSLI) to address a challenge faced by Takeda. This paper describes the collaboration as a case study of university researchers interacting with company executives to explore the potential of a new approach for undertaking organizational design.

The joint CIDL-CSLI project involved 38 executives from across Takeda applying principles from Thomas Malone's book *Superminds* to address an important business problem: how to use innovative socio-technical solutions to tackle depression among working age people in Japan. The Takeda executives, called "Superminds Fellows," participated in a series of face-to-face and virtual meetings that were informed by ideas from the fields of collective intelligence and design thinking.

The Takeda group generated six business concepts to address the challenge, and a group of researchers convened by the CIDL and the Community Biotechnology Initiative (CBI) of MIT's

Media Lab subsequently commented and expanded on these concepts. The ideas generated by the Takeda executives and the MIT group were then synthesized by the CIDL team and reviewed by all participants.

The concept that emerged was CareNet, a web-enabled collected intelligence system that relies on a combination of human expertise and artificial intelligence to diagnose and recommend actions that can help people who are susceptible to or suffering from depression, as well as their caregivers and healthcare providers.

The collaboration yielded multi-faceted results. First, Takeda is developing the CareNet business concept by working with key stakeholders in the Japanese healthcare system. Second, the superminds concepts introduced to the Takeda executives who participated have begun to proliferate across the organization. For instance, even though only 38 executives participated directly in the Superminds Fellows program, a Takeda survey found that through the end of 2019, more than 200 people at the firm have become familiar with the supermind concepts at the center of the CIDL-CSLI collaboration. Finally, for CIDL, the collaboration led to the development of new elements of its superminds design methodology and also provided insights into how universities can undertake activities that combine some of the benefits of both traditional university research and management consulting.

Introduction

Between March 2019 and February 2020, MIT's Collective Intelligence Design Lab (CIDL) worked closely with the Center for Scientific Leadership and Innovation (CSLI) at Takeda Pharmaceutical Ltd. The goal of the collaboration was to apply principles from Thomas W. Malone's book, *Superminds: The Surprising Power of People and Computers Thinking Together* (Malone 2018) to address an important business problem at Takeda.

The MIT Center for Collective Intelligence (CCI) launched the Collective Intelligence Design Lab in late 2018 (CIDL 2018). CIDL leverages years of multidisciplinary MIT research to work

with sponsor organizations in designing innovative new kinds of collectively intelligent systems that can solve important problems.

One way of framing CIDL's mission is that it seeks to design new kinds of *superminds*. The dictionary definition of supermind is "a powerful combination of many individual minds." Combinations of people—human superminds—have played a central role in the key developments in the history of humanity.

What's new today is that recent advances in information technology have created the possibility for people and computers, working together, to do things that were never possible before. CIDL thus focuses on designing new combinations of people and computers that can address, in novel ways, important challenges faced by corporations, governmental entities, and nonprofits.

Another way of thinking about CIDL's approach is that it represents a novel way to undertake the work of organizational design. The field of organizational design emerged in the 1960s and 1970s, with researchers who studied interactions inside the large, hierarchical corporations that had emerged in the late 19th and early 20th centuries (Chandler 1962). The field focused on how to coordinate activities and the flow of information among those who worked for different units of such corporations, which typically had functional groups, as well as ones focused on particular lines of business and geographies (Thompson 1967, Lawrence and Lorsch 1967, Galbraith 1973, Van De Ven et al. 1976, Nadler and Tushman 1997, Galbraith 2002).

The interconnectivity provided by the global buildout of the Internet has allowed for the development of new ways of organizing work that go beyond the methods established inside the hierarchical, multidivisional corporation. Many of these new practices emerged first inside university research groups, in small startup companies, or among groups of innovative software developers and Internet users working together without any formal institutional ties.

Many of these new ways of organizing work operate outside of or span traditional organization boundaries. Among these are crowdsourcing (Howe 2006), innovation contests (Bjelland and Wood 2008, Boudreau and Lakhani 2009), open innovation (Chesbrough and Appleyard 2007), online ratings (Dellarocas 2003), and clever methods to find people who possess highly specialized types of knowledge or expertise (Pickard et al. 2011, Atanasov et al. 2017).

Innovative new approaches also emerged for organizing work inside of organizations, including reliance on internal markets (Malone 2004) and use of market-based exchanges for making predictions (Nagar and Malone 2011).

Superminds provides a principled framework for considering these new organizational possibilities, and using superminds concepts creates the prospect of being able to design quite new kinds of organizations. These will not be the hierarchical corporations that were the focus of the first generation of researchers in the field of organization design. Rather, CIDL seeks to envision new kinds of entities that span formal organizational boundaries and rely on human groupings—such as markets, democracies, and communities—that in the past have not been considered part of the tool kit of organizational designers. In working with Takeda, CIDL sought to test out, in a real setting, its idea of applying superminds concepts to undertake this new way of doing organizational design.

The approach taken by CIDL in its engagement with Takeda has antecedents in action research, a method developed by social psychologists in the 1940s (Lewin 1946, Trist 1976 provides a review). Action research involved making planned interventions in a social system and subsequently undertaking close observation of the resulting impacts. The goal was twofold: to gain insights into the workings of the system under consideration and also to create positive change in that system. Approaches influenced by action research subsequently were employed in management science (Susman and Evered 1978), information systems (Baskerville 1999), and a number of other fields, including education and healthcare. A related influence in information systems has been the field of design research, which developed a set of structured methods for developing and then testing the impact of new computer systems in organizations (Hevner et al. 2004).

In its work with Takeda, CIDL also envisioned using tools from design thinking, a set of techniques initially developed by practitioners to facilitate the design of artifacts like industrial products or web sites and mobile apps (Brown 2008, Brown 2009). This approach has increasingly come to be applied to design interventions in human systems, for example, to address complex social problems (Brown and Martin 2015).

CIDL's project employed three phases: (1) defining the problem to be addressed and planning the work, (2) direct engagement between CIDL and Takeda, (3) evaluation of the results by CIDL. These stages map closely with the three-stage process developed in the early days of action research (Lewin 1946) and represents a streamlined version of the five-stage approach subsequently applied by action researchers in management science: diagnosis, planning, taking action, evaluating, learning (Susman and Evered 1978).

This paper is a case study (Yin 1984, Eisenhardt 1989) that describes and seeks to draw insights from the collaboration between CIDL and Takeda. It examines whether CIDL's new approach to organizational design, inspired by superminds concepts, yields novel and useful results. It also looks at the interaction between a university research group and a large business organization to identify ways such engagement might be improved in the future.

The authors of this study all participated directly in the work with Takeda. The paper was informed by the authors' experience during the project, by examination of artifacts created along the way, and by follow-on interviews with Takeda executives.

Research Site: Takeda Pharmaceutical Ltd. and its Center for Scientific Leadership and Innovation (CSLI)

Founded in Osaka, Japan in 1781, Takeda Pharmaceutical Company Ltd is one of the world's oldest and largest pharmaceutical companies. It is active in 80 countries and has nearly 50,000 employees. After Takeda completed its acquisition of Shire in January 2019, the combined company's annual revenues exceeded $30 billion.

In recent years, Takeda's leaders have come to recognize that several current trends—the set of emerging technologies associated with the fourth industrial revolution (e.g. artificial intelligence and robotics, autonomous vehicles, the Internet of Things, 3-D printing, nanotechnology, and quantum computing), the growing importance of new modes of collaboration, and novel business models—will require the company to begin working in fundamentally different ways. Takeda's people will not only need to possess the scientific and business acumen that characterized them

in the past, but also to exhibit deep curiosity, be able to work in agile and improvisational ways, and understand the potential of digital technology to augment traditional medical therapies.

To help the company develop the new capabilities needed to succeed in the future, Takeda's research and development (R&D) group formed the Center for Scientific Leadership and Innovation (CSLI) in early 2019. CSLI is based in Boston and led by Magdalena Schoeneich. SCLI's vision is to "prototype the future" by developing capabilities in 4 key areas (which it refers to as the 4Cs): *collaborative* networks, focused *curiosity*, *creative* energy, and *collective* intelligence.

Phase 1: Defining the problem and planning the project (March 2019)

When CSLI leaders learned about CIDL—especially its focus on helping organizations to design new configurations of people and computers that are more collectively intelligent—they viewed the two groups' missions as well aligned. Accordingly, CSLI and CIDL decided to launch a joint project. The overarching goal, based on CSLI's commitment to learning by doing, was to "activate the Takeda supermind" by having a group of executives from across the organization work together on a challenge of importance to the company. This approach would give people at Takeda direct experience of working in new ways, and it also had the potential to deliver a tangible business result. A core group from CIDL and another from CSLI held a series of meetings during March 2019 to plan the project.

The CIDL core group included Thomas Malone, faculty director of CCI and author of *Superminds*; Kathleen Kennedy, Executive Director of CCI; David Sun Kong, director of the Community Bio project at the MIT Media Lab and a CCI faculty affiliate; Desiree Dudley, a member of the Community Bio staff; Gianni Giacomelli, head of innovation design at CIDL and the leader of innovation activities at Genpact, a global professional services firm that delivers digital transformation to large corporations; Annalyn Bachmann, community manager at CCI; and Katharina Kramer and Paul Schlag, graduate students who were visiting MIT from the Technical University of Munich. Robert Laubacher, Associate Director of CCI, joined the CCI core team during a later stage of the project.

The core team from Takeda included Magdalena Schoeneich, director of CSLI; and four members of her team: Selena Della Rocco, Michael Serino, Riley Smith, and Riley A. Smith. In addition, two people based in Takeda's Japanese office worked closely with the members of the CSLI core team: Masaru Otsuka (who was a member of Takeda's IT group) and Reiko Onodera.

In planning the effort, the core group applied a framework developed by CCI, the Collective Intelligence Genome (Malone, Laubacher, and Dellarocas, 2010). The CI genome framework asks four questions about any activity: What is being done? Who is doing it? Why are they doing it? How is it being accomplished?

What

After an initial kick-off meeting and several follow up calls, the core group converged on an initial business challenge that would guide the effort:

> *What are innovative scenarios for how the healthcare system could be organized in radically new ways that leverage (digital and other) technology and have the potential to be dramatically better than today's system?*

As the core teams worked together, the leaders of CSLI also sought input from executives at Takeda headquarters in Japan. Takeda's traditional strength in neuroscience and the company reaching the milestone of treating its one millionth patient for depression were factors that led to development of a more tightly focused challenge:

> *How can we address depression in (working generation) Japanese adults using innovative socio-technical solutions (superminds)?*

This challenge was of particular interest for several additional reasons. The Japanese healthcare system presents interesting and distinctive challenges. And Takeda had also recently developed a new drug to treat depression that had significant potential in the Japanese market. There was also widespread awareness inside Takeda that the company, like the pharmaceutical industry in general, must look at the potential of moving "beyond the pill" toward hybrid therapies that

combine traditional drugs with new modes of treatment enabled by information technology. This challenge would encourage exploration along such lines.

With the challenge in place, the group then proceeded to address who would be involved, why, and how they would be engaged.

Who

The core team believed that a powerful way to spread the supermind design approach throughout Takeda would be to engage with a group of executives from across the company. The Takeda core group identified 38 people who would be designated as Takeda Superminds Fellows and participate in the initiative. Selection of the Fellows was done by the CSLI core group, with members of the CIDL core group advising them based on their experience building communities in several prior crowdsourcing projects. The Fellows were from different units within Takeda and based in Japan, North America, and Europe. Most worked in the areas of digital health, drug development, and corporate strategy.

Fellows were chosen to ensure that a broad range of expertise and diversity of perspectives were represented. Importantly, the selection process went beyond the usual candidates chosen for such exercises, that is, executives identified by senior management as having high potential. CSLI purposely sought executives with less typical profiles, relying on the extensive in-company network of CSLI's director to identify people who would bring enthusiasm and distinctive points of view. For example, several were millennials, who might typically have been deemed too junior to participate in such an exercise. Others were executives from unexpected parts of the Takeda (that is, not from R&D) or people identified by their supervisors as having unique perspectives that could be valuable for an innovation exercise. These "unusual suspects" were especially pleased to be included as Fellows and brought particular energy to the program.

Why

The Fellows recruited to be part of the initiative would have to participate while still fulfilling the responsibilities of their regular positions at Takeda. To encourage them to agree to participate, CSLI emphasized that being chosen amounted to recognition inside the firm, a designation that would be looked upon favourably by peers and senior management.

The program also sought to appeal to the Fellows' desire to explore innovative modes of helping patients. By emphasizing that the program was looking into novel, and potentially more effective ways of delivery therapies to those who need them, the program was aligned with Takeda's explicitly stated values of PTRB: Patient (Putting the Patient at the Center), Trust (Building Trust with Society), Reputation (Reinforcing our Reputation), and Business (Developing the Business).

The CSLI-CIDL collaboration thus relied heavily on two of the less conventional levers spelled out in the CI Genome framework, glory and love (the third is the more traditional motivational lever of money).

How

The CIDL and CSLI core teams worked together in developing activities for the Fellows. The approach employed first introduced the core concepts from *Superminds* and then invited the Fellows to apply those concepts to real business problems by using the principles of design thinking.

The core teams planned two face-to-face workshops for the Fellows, each lasting two days, one at MIT in April and another at a Takeda facility in Tokyo in May, with virtual meetings to be held in between. In addition, after the second workshop, a group of MIT researchers and affiliates—an MIT supermind—would provide input on the outputs generated by the Fellows.

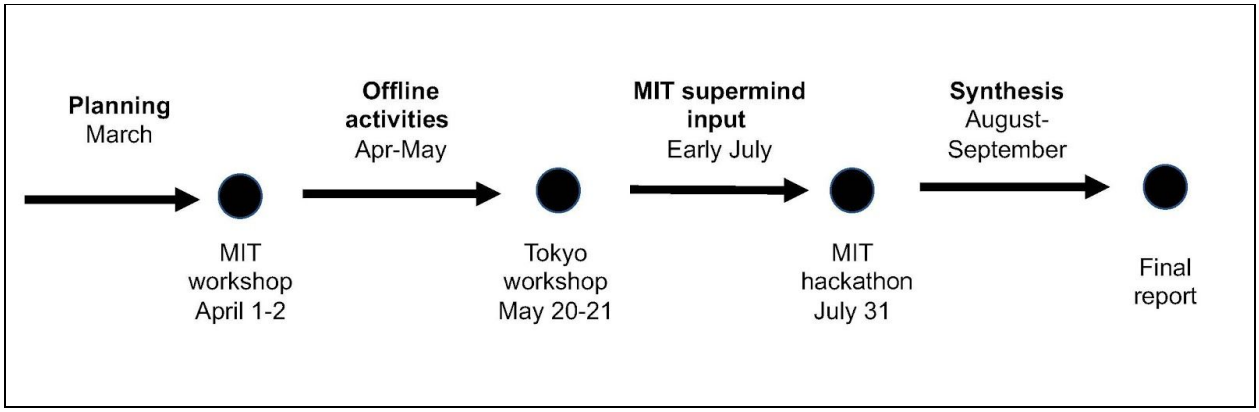

Figure 1: Sequence of activities in the CIDL-CSLI collaboration

Four key superminds concepts would be highlighted in the workshops with the Takeda Fellows:

- *hyperconnectivity*, enabled by advances in information technology, which is today allowing for new combinations of people, as well as new combinations of people and computers, that can accomplish things never possible before (Malone 2018, Introduction);
- *five cognitive processes* behind any effective action: sense, create, decide, remember, learn (Malone 2018, chapter 5);
- *five kinds of superminds* that can be used for making decisions: hierarchies, democracies, markets, communities, and ecosystems (Malone 2018, chapters 6-10);
- *collective intelligence genome* (the what/who/why/how framework described above used to guide development of activities in the CIDL-CSLI joint initiative).

After superminds concepts were introduced to the Fellows, they would then be invited to apply them to the business challenge by using exercises adapted from the field of design thinking. CIDL's reliance on design thinking was well aligned with CSLI, as design thinking is one of the four pillars on which CSLI chose to base its work. Key members of the CSLI team also had previous experience with design thinking and were well acquainted with the principles underlying it.

By introducing the Takeda Superminds Fellows to superminds concepts and then inviting them to apply those concepts through a series of design thinking exercises, the CIDL and CSLI core

teams envisioned that the Fellows could internalize new ways of thinking creatively about the problems they encountered in their daily work. Exposing the Fellows to these ideas and encouraging them to apply them would also serve to diffuse innovative ways of thinking throughout the larger Takeda organization, thereby bringing about systemic change.

Phase 2: Engagement between CIDL and CSLI (April-September 2019)

CIDL and CSLI collaborated in a series of live and virtual meetings that began in the spring and spanned into the early fall.

Cambridge workshop, April 1-2

The first face-to-face workshop took place on the MIT campus in Cambridge, Massachusetts on April 1-2, 2019. The primary goal for the first workshop was skill building: introducing the Fellows to superminds concepts and having them apply those concepts in a series of design thinking exercises. The expectation was that developing these skills in the first workshop would serve as a foundation that would allow the Fellows to undertake more effective ideation work in the subsequent workshop.

The Cambridge event began with a presentation by Andy Plump, President of Takeda R&D, who emphasized the importance of adopting new, collective approaches to innovation, in a spirit of curiosity and exploration. Magdalena Schoeneich, the head of CSLI, then reviewed the goals of the overall effort, Thomas Malone introduced superminds concepts, and David Sun Kong spoke on how to build collectively intelligent communities.

The Fellows were then shown a matrix laying out the primary steps in the process of addressing depression for a patient in Japan on one axis (prediction, prevention, diagnosis, treatment, adherence) and the key stakeholders involved on the other axis (physicians, hospitals, pharma companies, payers). They were invited to indicate the areas in which they would like to work, and based on that input, the core CSLI team assigned each Fellow to one of eight groups, with some groups covering multiple cells in the matrix (see Figure 2).

Group	Step	Stakeholders
Group 1	Prediction	All
Group 2	Prevention	Physicians, Hospitals
Group 3	Diagnosis	Physicians, Hospitals
Group 4	Treatment	Physicians, Hospitals
Group 5	Prevention, Diagnosis	Pharmaceutical companies
Group 6	Treatment	Pharmaceutical companies
Group 7	Prevention, Diagnosis, Treatment	Payors
Group 8	Adherence	All

Figure 2: Takeda Fellow groups for Cambridge workshop

The teams then worked on a series of exercises with the goal of getting the Fellows to develop initial ideas for addressing depression in Japan. Members of the core CIDL and CSLI teams were available to answer questions and provide support. The exercises included: problem tree analysis to encourage re-examination of the challenge anew so it could be seen from a novel perspective; mapping the journeys of key stakeholders; and using several approaches (reframing decision-making processes with the five supermind types, envisioning ways to use new technologies, and applying distant analogies) to identify creative new ways that existing processes might be reconfigured.

Applying distant analogies is a technique developed in the Process Handbook project (Malone, Crowston, and Herman 2003), a prior research initiative led by Thomas Malone. It involves

taking an example of how an activity is performed in a seemingly unrelated realm and imagining how such an approach might be applied in the domain under consideration. An example is "Could there be an Uber for dog walking?" (In the case of this analogy, two recent start-ups are actually striving to become the Ubers of dog walking: Wag! and Rover). This technique is similar to the design thinking concept of imagining "alternative worlds."

During the workshop, a topic that elicited much discussion was the stigma associated with depression in Japanese society, and participants explored a number of ideas for how it might be overcome. One was that social media influencers might be enlisted to reduce the stigma. Two interesting distant analogies were also proposed. The first was adoption of the product Cup of Noodles, which, over many years, gradually changed widely held cultural practices in Japan. The second was the role of the "safe space" of the sauna in Scandinavian culture, where men are able to speak openly about issues they would not otherwise discuss. This led to speculation on whether there may be comparable safe spaces in Japanese culture that could become sites where people who suffer from depression might speak more freely about their situation.

By the end of the workshop, many Fellows noted that being introduced to superminds concepts and applying them in the design exercises had opened up their thinking and allowed them to generate more creative ideas. The workshop also led to a recognition that the social stigma tied to depression was a central issue that would have to be addressed to diagnose and treat that disease more effectively in Japan.

Activities in the run up to Tokyo, April-May

Soon after the Cambridge workshop, the Fellows connected via videoconference to participate in two synchronous virtual activities.

The first was aimed at building a deeper understanding of the Japanese healthcare system and the complexities of mental health disorders in Japan. Two Takeda employees held a webinar that described a typical Japanese patient's journey in dealing with clinical depression.

The second was a journey mapping exercise that invited groups of Fellows to describe the typical

pathway key stakeholders might follow as they dealt with various stages in the process of addressing clinical depression. Fellows were encouraged to note pain points in these journeys as a way to identify where interventions could lead to improvements. The Fellows worked in the same groups they had in Cambridge, and during their brainstorming session, a scribe captured the ideas put forward using Padlet, an online collaboration tool.

While the Fellows were participating in these activities, the CIDL and CSLI core teams prepared for the Tokyo workshop. The core teams decided to have a smaller number of groups at the Tokyo workshop, focused only on physicians and caregivers and on only three stages in the process: prevention, diagnosis, and treatment. The Fellows were reassigned into six groups (see Figure 2).

	Prevention	**Diagnosis**	**Treatment**
Physicians	Group 1	Group 3	Group 5
Caregivers	Group 2	Group 4	Group 6

Figure 3: Takeda Fellow groups for Tokyo workshop

The core teams also worked together closely to develop new exercises for the second workshop. These included assigning specific roles to team members during the early ideation stage (e.g. data explorer, illustrator, contrarian); structured steps for idea generation, clustering, and evaluation; development of a concept map to communicate the essence of the proposed solution developed by the group; and finally, translation of that solution into a 3-7 frame storyboard. In addition, the CIDL team prepared libraries of distant analogies and new applications of technology that could encourage more creative brainstorming.

Tokyo workshop, May 20-21

A second, two-day face-to-face workshop was held at a Takeda facility in Tokyo. Masato Iwasaki, the President of Takeda Japan's Pharma Business Unit (PBU) and an executive sponsor of the collaboration, began the first day with a talk that provided a business perspective on the challenge question.

During the first morning, participants received additional input on the treatment of mental health disorders in Japan and on Japanese culture in general. A staff member from a Takeda clinic discussed the mental health resources available to employees and the processes in place to encourage employees to access these resources. A talk by a Shinto priest, who had formerly served as a diplomat with the Japanese foreign ministry, provided insights into Japanese history and religious traditions.

In the afternoon, Thomas Malone presented a new supermind design technique: a series of conceptual moves that could be used to take existing processes as a starting point and generate new ideas about how to perform business activities. Seven initial moves were presented:

- *verbify* (reframe the item under consideration as an activity by using a verb);
- *cognify* (identify which of the five core cognitive processes are involved);
- *supermind* (shift from an individual to a group perspective and speculate on whether one of the five supermind types could be employed as an alternative mode of decision making);
- *generalize* (reframe the activity as a more general type, e.g. from tracking travel expenses to tracking all expenses inside an organization);
- *specialize* (reframe an activity as a particular type, e.g. from tracking travel expenses to tracking international travel expenses);
- *distant analogies* (find an example from another domain that may be applicable, e.g. the Uber of dog walking);
- *technify* (identify ways of using technology that could transform how the activity gets done).

The Fellows then split up to begin work on the aspect of the challenge they had been assigned, with a facilitator from the CIDL or CSLI core teams working with each group. As noted above, the groups were charged with taking the perspective of a single stakeholder (physician or

caregiver) at a single key juncture in the process (prevention, diagnosis, treatment). The goal for the first afternoon was to develop a concept for a minimum viable product (MVP) to address the challenge from the designated perspective.

Since the groups had been newly reassigned, in many cases, the members had not worked together before. Because of this, some facilitators began with ice breaking exercises to build group cohesion. For example, one facilitator asked members of the group to describe what type of supermind their family of origin had been, that is, whether their family made decisions like a hierarchy, a democracy, a market, a community, or an ecosystem. This exercise, in particular, allowed Fellows to relate to a key superminds concept in a highly personal way and also helped members of the group get to know each other. After the ice breakers, the groups set to work.

At the end of the first day, the Fellows were invited to take a field trip to their choice of several locations throughout the city—a shopping mall, a park, a bar, and a Shinto shrine. This was an empathy exercise, a tool from design thinking, which relies on the use of ethnographic observation. Fellows were invited to watch how people interacted, with the idea that observing everyday life in Tokyo would provide a deeper understanding of Japanese culture, and in particular, how Japanese people socialize in informal settings. The idea was that this could provide insights that could prove useful in thinking about the prevention, diagnosis, and treatment of depression.

During the second day, the groups finished developing their concepts and created story boards—visual representations of their ideas. Each group then gave a brief presentation to their peers and fielded questions from members of the CIDL team.

The groups generated six concepts (for more on detail on these concepts, see Ammirato et al. 2019):

- Group 1: Physicians/Prevention

  Smile@Work and Smile@Life, an application that allows physicians in Japan to sense the magnitude and impact of stressors that might trigger reactive depression among employees.

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- Group 2: Caregivers/Prevention

  This group defined the caregiver not as a spouse, parent, or other family member, but rather, as the employer. In this concept, the employer provides access to a toolkit of apps, wearables, trackers, and other solutions encouraging employees to be healthy.

- Group 3: Physicians/Diagnosis

  This concept calls for development of a diagnostic tool that measures symptoms of depression with a daily happiness rating. It can identify risk indicators for depression by identifying patterns associated with depression.

- Group 4: Caregivers/Diagnosis

  This group proposed a public health campaign across all media to promote understanding, acceptance, and treatment of mental health and depression in particular. This campaign would be financed either by the Japanese government or by a public/private partnership.

- Group 5: Physicians/Treatment

  This group proposed the DEMI (Diagnosis, Education, Monitoring, and Interpretation) Care system, which integrates active and passive data collection of critical markers of wellbeing from the patient, family, healthcare providers, and community members.

- Group 6: Caregivers/Treatment

  CareNet seeks to extend the traditional, closed household relationship by providing caregivers online access to digital counselors, virtual communities, and volunteers. CareNet would match caregivers in difficult situations with people to help them across time, space, and culture.

Input from MIT supermind, July-August

After the Tokyo meeting, the groups of Fellows were asked to write up their concepts in greater

detail so they could be reviewed by a supermind made up of researchers connected with MIT.

CIDL and the Community Bio initiative at the MIT Media Lab recruited 14 MIT affiliates—the MIT supermind—to provide input and further develop the six ideas put forward by the Takeda Superminds Fellows. The six concepts were posted online in early July, and over the next several weeks, members of the MIT supermind were invited to comment on and provide suggestions for how the ideas could be enhanced.

On July 31, a ninety-minute, synchronous online hackathon was conducted with members of the MIT supermind. Participants were guided through a series of structured design thinking exercises to elicit new ideas about how to address the challenge. There were two phases of ideation during the Hackathon. In the first, members of the MIT Supermind contributed ideas on the objective of the initiative, potential approaches for meeting the objective, and incentives that could encourage participation by key groups (these three topic areas mapped to What, How, and Why in the CI Genome framework). In the second phase, members of the MIT supermind were invited to cluster the ideas they had generated in the prior phase. As with one of the virtual events for Takeda Superminds Fellows before Tokyo, Padlet, an online collaboration tool, was used to collect and group contributions.

Synthesis, August-September

Gianni Giacomelli, CIDL's head of innovation design, with input from the CIDL team, reviewed the six concepts developed by the groups of Takeda Superminds Fellows, plus the comments and new ideas contributed by the MIT supermind, and identified the key themes. He then integrated these themes into a single concept that incorporated the most promising ideas contributed by both the Takeda Fellows and the MIT supermind. Such a process is commonly followed in corporate innovation activities. Group innovation efforts like the one undertaken by CIDL and CSLI typically generate a set of divergent ideas during early stages, and these ideas then get combined in a final synthesis to generate investment grade business concepts.

Concept generated by the ideation process

The solution that emerged from the synthesis was CareNet (Ammirato et al. 2019), a technology-enabled collective intelligence system to detect signs of depression in individuals and suggest actions, with different levels of interventions based on the severity of the case. The system would be of value both to people at risk for, or already suffering from, depression, as well as to their caregivers and healthcare providers. The system would have two primary faces.

The first, Smile@, would target "happiness seekers" who are hoping to enhance their sense of well-being. This feature was seen as central because it could reduce the potential stigma associated with use of the platform and at the same time, attract people whose concern for enhancing their well-being might be an early signal that they are at risk for depression. The Smile@Life version was envisioned as being available for use by anyone, while the Smile@Work version would be a password-protected application offered as a health benefit by employers.

The second face of CareNet envisioned was Diagnosis, Education, Monitoring, and Interpretation (DEMI), aimed at people who have already been diagnosed with depression. As with Smile@, DEMI would have a version available to the general public as well as a corporate version that could be provided by large employers to members of their staff.

The diagnosis and treatment recommendation engine in CareNet would be informed by a broad range of inputs, including direct contributions by users, plus inputs from people close to the users, and signals such as social media posts, mobile phone sensors, and even broad environmental factors that have been shown to influence depression, such as weather. CareNet would diagnose depression in users and recommend appropriate treatments using a collective intelligence system, comprised of people with mental health expertise, assisted by artificial intelligence (AI) algorithms. Through usage, the CareNet system would accumulate data over time, which would allow for continual improvement in the performance of its algorithms.

It was recognized that developing such a system would require collaboration by multiple stakeholders, including government, business, and the social sector. Launch would also require a significant communication effort. And to gain the trust of users and people around them, the

system's privacy assurances would have to be ironclad (for a full description of CareNet, see Ammirato 2019).

Phase 3: Evaluation, October 2019-February 2020

After the engagement had been completed, the CIDL team evaluated

- the business concept generated by the ideation exercise,
- the organizational outcomes for Takeda,
- learnings gleaned by CIDL.

Potential business impact of the concepts generated

CSLI judged the business concept developed in the collaboration to be interesting and richly detailed. CSLI is exploring implementation of the concept, via an open source approach. The concept would be made available, as a public good, in the hope that an existing organization or a social entrepreneur would take the lead in making the concept real. Takeda would provide the blueprint, knowledge transfer, and mentorship, and also recruit partner organizations and potentially provide seed funding.

The Takeda Fellows could also serve as a resource for the organization that takes the lead in implementing the concept. In addition, vetting of the idea before launch with people whose expertise lies outside of the realm of medicine and healthcare, which was the background of the Takeda Fellows and the members of the MIT supermind, could also help to make the concept more robust going forward. Input from people with tech expertise could be especially valuable.

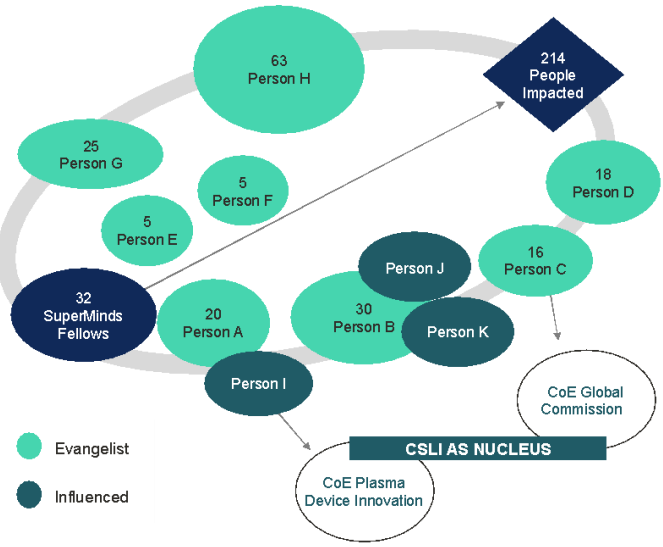
Evaluation of the organizational impact at Takeda

After assessing the organizational impact of the effort, the CSLI core team felt their expectations had been exceeded. Word of mouth feedback from the Fellows who participated in the program was positive; they noted particularly that the experience made them recognize the value of

working together with people from different parts of Takeda to solve complex problems. In the months prior to the launch of the project, the demands of working on a major acquisition had meant that people at Takeda, as well as legacy Shire employees, had very much been focused on daily deliverables. The opportunity to participate in a program that took people outside of their routine, and stretched their thinking, was very welcome, both for its own sake and as a signal that the company was willing to invest in them.

Responses from surveys conducted by Takeda after both workshops and at the conclusion of the project confirmed these positive sentiments. After the Tokyo workshop, 100 percent of respondents said they were somewhat or very likely to share the methodologies they had learned with their teams. 93 percent said they would be somewhat or very likely to recommend the Fellows experience to colleagues.

CSLI also undertook an analysis of the diffusion of superminds thinking throughout the organization. A survey tracked the initial group of Fellows and the contacts they made as they shared superminds concepts with colleagues. CSLI called Fellows who served as evangelists in this way "spores," based on the idea that they were, as biological spores are, agents of organic diffusion. The evangelists who experienced the workshop directly were able to create other evangelists, who in turn, spread the ideas further. CSLI's analysis identified more than 200 people inside Takeda who had been influenced by superminds thinking via direct or second-order evangelists (see Figure 4). In addition, CSLI's analysis showed that several Takeda units outside of R&D, most notably, groups involved with the design of medical devices and developing new modes of working with payers, had been influenced by superminds thinking.



Figures inside oval indicate number of colleagues informed about collective intelligence concepts by that individual.

Who	Unit	Why	People impacted
Person A	Plasma Medical Device	Device Innovation	20
Person B	R&D Partnership Office	CRO Collaboration	30
Person C	Global Commission	Provide catalyst to innovation process	16
Person D	Operational Excellence PVPA	Payer negotiations	18
Person E	External Innovation	Technology partnership	5
Person F	PV Services	Team development	5
Person G	Global Outcomes Research & Epidemiology Innovation	New outcomes tool	25
Person H	IT/Medical Affairs	Team development	63

Figure 4: Diffusion of collective intelligence concepts across Takeda after workshops

Comments by participants in the program added texture to the survey findings and CSLI's analysis of the diffusion of collective intelligence concepts:

> [I learned] not to rush to solutions but instead to take the time to be creative and a bit crazy in creating a wide variety of options to consider—taking the time to think "broad and wide" in terms of options to create a large funnel. Only after doing this should one then begin to consider narrowing the focus.

> Ensuring that a problem is framed from a diverse viewpoint is incredibly important to open up the full issue and the full complement of opportunities to solve it. Clearly collaboration and cross-department networking is critical to the optimal solutions. The main thing I do differently [now] is really think broadly in the beginning. In the work we did, we were encouraged to think broadly and propose even crazy ideas. The value of that approach is it allows you to include aspects that you would not have considered if you

started with a narrow funnel and never expanded out.

Digital solutions, although not the only kind of solution, should be considered in every conversation as a potential option. The reality that digital has a place to some extent in future solutions with Takeda needs to be included in conversation but does not mean that it is the ultimate solution. Digital may be a contributing piece to the larger solution discovered through this process.

It has reinforced my natural style to be inclusive and collaborative. In the past I used this style because it came naturally to me and I found success with it. Now I understand why this style is successful in that it brings in the various superminds and perspectives. This experience also encourages me to remain a creative and innovative thinker despite the feedback one receives in many large corporations to focus on "gravitas" and to conduct oneself in the manner expected to advance to more senior positions.

Particularly heartening to CSLI was the discovery that the thinking generated by the initiative had branched off into unexpected directions and spawned a set of emergent activities, including some that extended beyond CSLI's home R&D unit and into business areas beyond the domain explicitly identified in the challenge question. For example, a medical devices group in Takeda expressed interest in applying a superminds approach when developing a next generation product, as a way to prompt more patient involvement in the design process.

Learnings for CIDL

In this collaboration, CIDL was able to learn in two key areas: (1) developing a methodology for innovative organizational design, and (2) exploring the relationship between university research and management consulting.

Developing a methodology for innovative organizational design

The collaboration provided an opportunity for CIDL to develop its supermind design methodology and obtain feedback on it. Prior to the outset of the project, CIDL had developed a set of principles about how superminds work. Over the course of the project, it was able to build on that foundation and generate a set of novel techniques that would allow people in businesses and other organizations to use supermind principles in designing new configurations of people and computers.

The primary new technique that emerged from the collaboration was the notion of conceptual "moves" that would allow people to explore, in a systematic way, the design space for addressing a business challenge. This idea emerged in the time between the Cambridge and Tokyo workshops. At one of the team meetings, David Sun Kong suggested that it would be possible to identify a decision currently made by single person or a defined group and to "supermind" it, that is, consider how that decision might be undertaken by one of the five types of superminds (hierarchy, democracy, market, community, or ecosystem).

Upon hearing this comment, Thomas Malone recognized that this idea of "superminding" a decision process was a way of exploring a key aspect of the design space of alternative approaches for undertaking the activities under consideration. And he saw that additional superminds principles, along with ideas from complementary prior CCI research, could be used to develop other techniques for systematically exploring that design space. He coined the term "conceptual moves" to describe these techniques, since they provided a structured way to move from current practice and explore potential alternatives. For the Tokyo workshop, he prepared a presentation outlining seven such moves (see Figure 5).

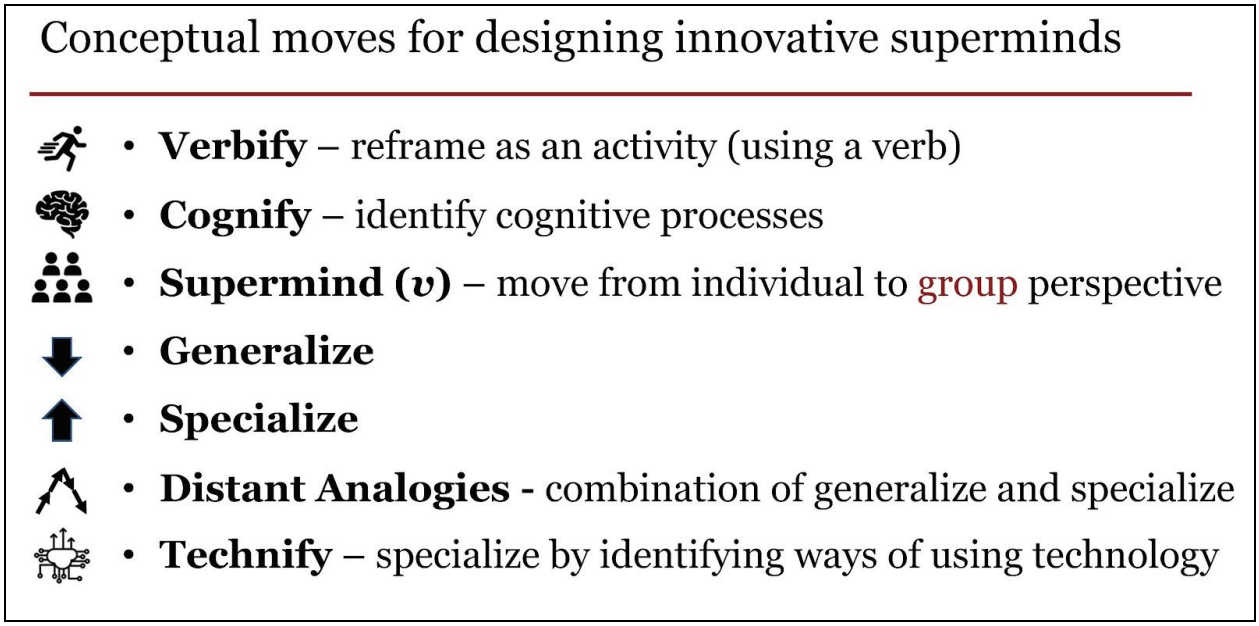


Figure 5: Conceptual moves presented at Tokyo workshop, June 2019

Since the workshop, CIDL has continued to develop these moves. Four new ones have been added:

- *Zoom in* (to focus on a *part* of an activity);
- *Zoom out* (to focus on a larger *whole* of which this one is a part);
- *Assign* (specialize an activity by determining *who* will do it);
- *Incentivize* (specialize to select how to *motivate* an actor to undertake an activity, e.g., money, glory, or love (Malone et al. 2010).

In addition, the move initially called *Supermind* was renamed *Groupify* to make clearer that it involved shifting to a group perspective, and *Distant Analogies* was renamed *Analogize*, for consistency's sake (after that change, all of the moves were designated by verbs).

These moves allow for structured exploration of design options, informed by superminds principles and complementary CCI research, and represent a novel contribution that emerged from CIDL's collaboration with CSLI. These moves address one of the limitations of design thinking, which lacks a set of formal methods for conceptualizing large systems, made up of combinations of people and computers. CIDL's conceptual moves provide a systematic way of

examining how such large systems could be marshalled to address complex challenges.

The technique of using conceptual moves to explore the design space is primarily useful during the ideation phase of developing new approaches for addressing business challenges. Since wrapping up this collaboration with CSLI, CIDL has also begun work on tools to assist in the other phases of the design process, both upstream (problem definition) and downstream (evaluation/selection from the set of options identified during ideation; and implementation).

Another area where CIDL has developed the supermind design methodology has been through development of initial content for a Superminds Design Library (SDL) and early work on software tools to provide access to that content. SDL will allow users to search systematically for analogies and other concepts that suggest alternative ways to accomplish a particular task.

As the CIDL team reflected on its progress in developing the supermind design methodology, a key question that arose was how to assess the relative contribution of the methodology itself, as contrasted with the role of the creative inputs of participants at key junctures in the process (the latter includes ideas contributed by the Takeda Fellows, ideas contributed by the MIT supermind, and the work done during the synthesis).

Given the data available to us, it's not possible to assess conclusively the relative weight of each in a scientific way. But the survey done after the Tokyo workshop suggests that the Fellows judged the methodology to be useful: 86 percent of respondents said that the supermind methodology they learned would impact their work at Takeda some or greatly.

Additional evidence for the value of the methodology came from Gianni Giacomelli, CCI's head of innovation design and an executive who has led innovation workshops with large companies for many years. In his judgment, many key elements of the business concept that came out of the CIDL-CSLI collaboration emerged because of the emphasis on applying supermind thinking at the heart of the methodology. Among the elements of the solution that had a distinct superminds flavor were:

- CareNet's reliance on both technology tools (sensors, analysis of online behaviour, machine learning algorithms) and a network of experts and the community of friends, colleagues, and caregivers who know a person who is susceptible to or is suffering from depression;

- the system's application of knowledge gleaned from the experience of prior users to refine its recommendations;
- recognition of the importance of including not only the person who is vulnerable to or suffering from depression but also the people surrounding them who may be affected and could contribute crucial knowledge to make the system more effective;
- awareness of the importance of reaching users at multiple touchpoints, ranging from when they are susceptible, to when they are actually suffering from an incidence of depression, to when they are actively receiving treatment;
- a realization that there can be a broad social component to depression, which led the incorporation of a feature that would assess the "mental weather" to identify times when users may be particularly susceptible to depression.

Exploring the relationship between university research and management consulting

In this collaboration, CIDL also gained insights into how to undertake hybrid activities at the intersection between university research and management consulting. University research seeks to generate new general knowledge, often by pursuing the curiosity or creative insights of the investigators. In addition to achieving that goal, CIDL also seeks to help its collaborating organizations develop novel designs of collectively intelligent systems ("superminds") that help solve business problems, such as greater innovativeness or improved efficiency.

Improvements of this sort are very much what management consultants seek to deliver for their clients, which means CIDL's activities overlap in some ways with those of consulting firms. Figure 6 maps one view of typical differences between university research and management consulting.

	University Research	**Management consulting**
Goal	Develop general knowledge and make it broadly accessible to the world	Recommend improvements in existing practices for specific clients

Value for sponsor/client	Gain early/privileged access to insights, which may confer advantage (but with no guarantee)	Gain direct business value, such as increased competitive standing or operational efficiency
Decision making	Principal investigator (usually a faculty member) directs students/ researchers; sponsor receives updates (does not co-direct work)	Tightly defined; partner at consulting firm works closely with commissioning executive at client
Incentives	University staff typically motivated by a desire to expand knowledge and make an impact; executives at sponsor engage out of interest in the research and long term potential to yield benefits	Generous salaries and prospect of advancement for consulting team; association with high profile company initiative for executives at client
Schedule	Work proceeds in parallel with university's academic calendar, subject to multiple competing priorities of university faculty and students	Tightly adhered-to schedule featuring frequent milestones, often with a substantial proportion of project staff assigned full-time to the project.
Collaboration technology	Can vary widely, depending on size/geographic distribution of team; open source tools often favored	Proprietary tools facilitate collaboration among geographically/organizationally dispersed working groups
Methodology	New methodological tools may be developed as part of the research	Well-honed methods developed in multiple prior projects often used

Figure 6: University research and management consulting compared

Differences between these two modes of working led to challenges in the collaboration across several dimensions.

Decision making. Because CIDL was responsible for the research aspects of the work and CSLI was responsible for approving use of their employees' time, there was ambiguity about who was directing the effort. Decisions were typically made through detailed (sometimes difficult) discussions and after emergence of rough consensus among the members of the two core teams.

Incentives. Incentives were not a major issue for the CIDL and CSLI staff, as both were highly motivated to see the project succeed. But eliciting steady participation from the Takeda Fellows, whose primary responsibility was to their regular jobs, proved challenging. Some Fellows were engaged throughout; others only gave focused attention during the face-to-face workshops. Alternative models of engaging company executives might be explored in the future. For example, more experienced participants could be paired with more junior ones, with the former contributing expertise in short bursts of time and the latter devoting more hours.

Schedule. The schedule for the collaboration was aggressive, in line with what might be seen in a consulting engagement. But staffing levels were not commensurate with what a consulting firm would typically field for a similar effort, which led to both core teams being overtaxed at times, especially in the run up to the workshops.

Collaboration technology. The IT infrastructure supporting the project was assembled by CIDL very quickly and on the fly. At times the tools deployed initially (Google Docs and Slack) were seen by the Takeda IT group as being insufficiently secure. In the future, CIDL could consider two possible alternative approaches: getting clearance from the collaborating organization for use of relatively open tools; or relying on the collaborating organization's internal IT tools, which would require CIDL team members obtaining guest privileges.

Methodology. Perhaps the most striking contrast between traditional research and management consulting was that CIDL was developing many of its methods in real time as the project progressed. CCI had in place a set of workshop materials on collective intelligence that had been used previously in talks by Thomas Malone. But because this project involved using these concepts in novel ways, new materials had to be developed for the collaboration.

Developing materials for the workshops required an all-hands-on-deck approach, with CSLI contributing significantly at key junctures, especially in the run up to the Tokyo session. Several members of the CSLI team were fluent in design thinking and thus were able to contribute in this way.

To make future workshops run more smoothly, CIDL could work to codify selected exercises developed in this collaboration. Among the materials that could be valuable are:

- descriptions of the activity in a leave-behind for participants after the facilitator has finished describing the exercise verbally (including, importantly, a concise articulation of the desired outcome);
- templates to collect outputs from workshop participants;
- team building exercises to encourage effective collaboration between people who may come from very different backgrounds and contexts (one example: the ice-breaking exercises used by some facilitators in Tokyo).

Future work

As noted above, Takeda is exploring how it can encourage implementation of the business concept developed in the collaboration. And CSLI plans to continue its work of encouraging diffusion of supermind design concepts inside Takeda. As one member of the CSLI team put it, in describing the nature of organizational development and change: "It doesn't happen from a single workshop or even several. It's a campaign."

CIDL is continuing to develop its supermind design approaches, with the goal of using them with

other organizations and continually improving them based on feedback. By documenting the collaboration described here, we hope both to facilitate further development of these design approaches and also to learn generalizable lessons about a novel way for universities and other organizations to work together.

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Appendix: List of participants

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