the catalyst culture
playbook

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To our valued collaborators

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Image Credit: Linda A. Cicero / Stanford News Service

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mediaX was a brilliant addition to the H-STAR Institute. mediaX was an industrial affiliates program that brought Stanford and industry together on topics that combined issues of human performance with technological solutions. The program masterfully listened to the interests of industry and then cast those interests into a form that captured the imagination of faculty. mediaX was quintessentially Stanford — daring, highly interdisciplinary by design, solution focused, and connected to the industries that can inform and bring ideas to scale. As a faculty member of mediaX, I am grateful for the opportunities to learn, collaborate, and contribute. As the Dean of the Graduate School of Education, I am thankful for the Playbook, as we create new partnerships that can leverage the revolution in our abilities to advance human learning.

Dean, Daniel L. Schwartz

Dan Schwartz

Guided by President John Hennessey's leadership, Stanford University embraced tackling big important problems that require ambitious thinking unbound by disciplinary boundaries and existing research traditions, to see problems afresh and collaborate in new ways with the enthusiasm of boundary crossing and cross-pollination that is required by a robust ecosystem. Our mediaX program sought to contribute to this effervescent vision. I would like to thank everyone who participated in our mediaX community over these several decades for expanding the spectacles and tools we use to see, think about and act to positively advance the human sciences at the multifaceted nexus of people and media technology socio-technical systems.

Faculty Director, Roy Pea

Roy Pea

On behalf of the advisors, staff and members of mediaX at Stanford University, I express my deep appreciation for the trust and confidence placed in the mediaX team to appreciate your challenges and contribute to your solutions.

Our relationships with the mediaX community energized and inspired our work. We humbly acknowledge the intellectual strength and generosity of the Stanford research community in providing thought leadership and in engaging in exploratory dialogues to share early results, preliminary findings, and nascent research questions. mediaX members' intellectual curiosity and drive for practical applications have been a continual source of energy and motivation. mediaX Faculty Directors' trust and confidence in our implementation of the virtuous cycles of mutual benefit for catalytic impact allowed us to take risks to explore new intellectual intersections and programmatic formats. The continual support of the H-STAR administration shielded us from most administrative burdens and allowed the lean mediaX team to focus on our activities as catalysts. The always-positive mindset of the highly capable mediaX staff and consulting team was consistently heroic in implementing ambitious programs. Our journey together has been a fascinating and rewarding priviledge.

mediaX ceased its formal operations on March 31, 2022. Many believe the mediaX "DNA" that now resides in its participants will continue as a positive force in creating a better future for all. This Playbook is for all who would like to keep that effort going.

Executive Director, Martha G. Russell

Martha Russell

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The mission

mediaX at Stanford University brought together businesses and Stanford researchers for open and mutually-beneficial explorations of the problems and possibilities arising from the growing ubiquity and reciprocal influence of humans' use of information technologies.

Image Credit: Linda A. Cicero / Stanford News Service

The goals

- Create opportunities for interactions that benefit both business and academia
- Interpret “media” broadly to refer to a range of socio-technical systems
- Value the “X” in mediaX which stands for cross-disciplinary exploration
- Promote sharing to the maximum extent possible while respecting proprietary needs
- Listen to, revere and validate the problems, questions, explorations, and ideas of all participants to ensure respect and foster creativity
- Recognize and problem-solve around differences in approaches and logistical realities of university and industry, as well as cultural norms of participants from around the world

Image Credit: Andrew Brodhead

The courtyard between Codura Hall and Ventura Hall, both of which housed mediaX offices over time.

Tatsuro Ichihara, former technology executive at OMRON describes how his queries to Stanford led to the founding both of an R&D organization in the company, and the establishment of mediaX at Stanford University.

OMRON's success in accomplishing the dream of its founder, Kazuma Tateishi, to create an R&D organization for the company, has been due to mediaX. Kimihiko Iwamura, consultant to OMRON, and I travelled extensively in the U.S. during the 1990's, visiting many university labs and gathering ideas. We met good people at Stanford and established a successful collaboration with Cliff Nass and Byron Reeves based on their groundbreaking "The Media Equation" research. It became clear to OMRON that collaborating with their Stanford network through mediaX would provide a multiplier effect. OMRON joined for a 3-year period. We learned how to create an open R&D organization, with seed funding for new initiatives and open innovation. OMRON built a new R&D facility with no internal walls so people could see what others were doing and communicate freely. Owing to this transformation inside the company and gaining a reputation among Japanese companies as a leader in open innovation, OMRON was selected out of more than 4,000 companies to be one of six strategic partners with Sony. Indirect benefits came later from other strategic partnerships, such as Panasonic, Osaka Gas, and Japan's Ministry of International Trade and Industry. OMRON's processes for researchers to talk with other researchers — in universities and in competitor companies — was copied by other companies."

Co-founder of mediaX, Byron Reeves, Paul C. Edwards Professor of Communication and (Courtesy) Education, Senior Fellow at the Precourt Institute for Energy, and Co-founder and Director Emeritus of H-STAR Institute, described the need for interdisciplinary work that was evident at the organization's founding. ***"There was a lot happening in terms of research. A lot of Stanford people needed to be talking to each other, and literatures needed to be linked. New programs needed to be developed to maximize the intellectual potential of all these collaborations. But it was also the case that there were many companies who were building stuff that had tremendous potential to influence terrible things and wonderful things all at the same time. It's critically important for anybody talking about technology to be steeped in what companies are building, why they're building it, what they think it can do, as a business, as an influence."***

Roy Pea, David Jacks Professor of Education & Learning Sciences in the Stanford Graduate School of Education and (Courtesy) Computer Science, Director and Co-Founder of H-STAR, and Faculty Director of mediaX at Stanford University, reflected on the importance of incentives for creating change. ***"It was important to identify the relevant motivations and rewards to help each party, industry and academic, find incentives for collaboration in the context of their existing locations. What was the incentive for a company to pay for a membership when they're not going to own the intellectual property? Why would a faculty member want to talk to people about problems they don't currently own or work on? It turns out that the important problems at cross-disciplinary boundaries are vital sources of creativity and insight, and discussions about these can centrally contribute to innovation."***

Keith Devlin, Roy Pea, Byron Reeves and Martha Russell recognize the co-leadership of Roy and Byron at the 2018 mediaX Member Appreciation Event.

User's Guide to the Playbook

Block and Tackle

User's Guide to the Playbook

This Playbook responds to requests expressed by many mediaX participants and collaborators, from Florianopolis, Brazil to Guangzhou, China to Tokyo, Japan to Dubai, United Arab Emirates and more, who wished to reproduce or adapt the success of mediaX at Stanford University in their own locales, businesses and institutions around the world. At the same time, it celebrates the accomplishments of the individuals and companies who participated in the mediaX program over the past twenty years. Participant recollections serve as mini-case studies, sprinkled throughout the document.

mediaX was born and located within Stanford University, the academic institution which gave rise to Silicon Valley as a hub of innovation, creativity, technical prowess, and entrepreneurship. Many of the unique approaches described in this mediaX Playbook leveraged that nexus to create a dynamic force at the start of the 21st Century.

The Playbook aims to serve users who wish to read it in a linear manner, as well as those who prefer to dip into the sections that address their most pressing needs or to reminisce and connect with participants they met during their mediaX journey.

The heart of the Playbook consists of two sections discussing the approaches that mediaX used to address the problems and opportunities inherent in marrying university research and industry needs together, called "The Virtuous Cycle."

"The Virtuous Cycle" seeks to capture the cyclical and iterative processes by which academics became more familiar with industry needs, and industry engaged with university research in a process benefitting both. Two chapters present the challenges of virtuous cycles: creating the culture of a catalyst and creating a culture of mutual benefit. In each, experiences with the mediaX program are recalled by corporate and university affiliates.

The virtuous cycle of a catalyst culture

- How can we implement a catalyst culture?
- How do we find, vet and on-board industry members into a catalyst culture?
- How does a catalyst help industry frame inquiry that aligns with scholarly goals?
- How does a catalyst engage university researchers with industry questions?
- How do we streamline administration of the catalyst role?

The virtuous cycle of mutual benefit

- How do we build relationships that support a multidisciplinary research community?
- How do we facilitate the exploration of new ideas?
- How do we recognize accomplishments?

Sections in the each of these Virtuous Cycle chapters address specific needs, based on questions mediaX has received from other organizations seeking to create a catalytic function.

The final chapter, Pass the Torch, offers encouragement to all who seek to address the critical challenges of the future at the intersection of people and the broad scope of information technologies we call "media." Importantly, it refers to Appendix 6 in which Questions for the Future, curated from over 50 interviews with mediaX thought leaders at Stanford and in mediaX member organizations, frame needs for further research and, of course, interdisciplinary collaboration.

The Appendices provide detail:

Appendix 1 describes the emergence and evolution of mediaX.

Appendix 2 provides numbers relating the reach and accomplishments of mediaX.

Appendix 3 identifies the Stanford mediaX H-STAR ecosystem.

Appendix 4 identifies organizations that have been mediaX members, 2001-2022.

Appendix 5 describes membership levels and benefits that mediaX offered its industry members.

Appendix 6 offers Questions for the Future to guide the continuing work of innovation for human good.

Appendix 7 details mediaX Research Themes and funded Projects.

Appendix 8 lists mediaX Researchers at Stanford and Visiting Scholars.

Appendix 9 offers a sharable description of the job of Director of an industry affiliate program at a leading university.

You are invited to create your own journey through this Playbook, find the ideas that are most valuable to you and adapt them for your unique context.

Most importantly, play nice. *Sportsmanship matters!*

Enjoy the quest!

The Virtuous Cycle of a Catalyst

Get on the Same Page

The Virtuous Cycle of a Catalyst

For twenty one years,[1] the mediaX Program at Stanford University enabled, through business membership funding, more than 120 research Projects[2] across a wide variety of disciplines. These projects, inspired by concerns brought to Stanford by a broad spectrum of corporations, gave myriad opportunities to Stanford researchers,[3] as well as to industry colleagues.[4] The success of these affiliations between academia and industry pays tribute to mediaX's role as catalyst. Because the nature of inquiry was often iterative or cyclical, mediaX termed this process "The Virtuous Cycle."

Starting lineup

How can we implement a catalyst culture?

A catalyst facilitates new beginnings — it sparks or accelerates reactions. A catalyst effects the mechanism and the speed of reactions; its energy is altered with accelerators. mediaX served as a catalyst between individuals, organizations, and academic research departments. It operated through a variety of accelerating mechanisms, including: attracting, vetting and on-boarding member corporations; funding early-stage research; introducing new faculty to the mediaX community; supporting graduate students; and building a network of connections that enabled faculty and business colleagues to inspire each other through exposure to new people and new ideas.

1 Read about the history of mediaX at Stanford University in Appendix 1: Emergence and Evolution.
2 See Appendix 2: mediaX at A Glance for quantitative outcomes of mediaX programs. Explore the full range of multidisciplinary research made possible by mediaX and its corporate and academic collaborators in Appendix 7, or at https://mediax.stanford.edu/research-projects/.
3 See Appendix 3: Stanford mediaX H-STAR Ecosystem and Appendix 8: mediaX Researchers and Visiting Scholars.
4 See Appendix 4: mediaX Members, 2001-2022.

For mediaX, accelerators for its catalytic function came in a variety of forms. The central catalyst was the entity of mediaX itself, whose primary mission was to bring together university expertise and business interests for the benefit of both realms, typically to enhance and augment investigations of the relationships between humans, media and technology. Fulfilling this mission required nurturing the resulting relationships through years of research collaborations. mediaX events, with their axioms of openness and safety — every inquirer and inquiry valued — also served as activators. In addition, once research questions were refined and Projects were granted seed funding, those resources served as a delta function to bring research to the point of proof-of-concept and beyond, including business start-ups initiated by graduate students, laboratories started by new professors, and parallel paths taken by industry. Importantly, the corporate and academic leaders who came to mediaX and were open to the methods they found there became catalysts themselves.

In its catalyst role, mediaX addressed a major industry need. It can be challenging for an industry researcher to know who on campus is working on specific topics and how to reach out to them. Without a Stanford concierge function, websites and published papers provide some insight, but they rarely state the current projects explicitly and seldom disclose the next intended study.

> ***"I describe mediaX as a gateway for approaching Stanford's faculty experts doing research relevant to our work at Fujitsu Research,"*** reflected Kanji Uchino, Senior Researcher and Project Leader at Fujitsu Research, Inc. ***"It's hard to know from website information which professors we can approach. In addition to meeting professors at mediaX conferences and other meetings, mediaX has given us very good recommendations of experts we can talk with. Together, we have a productive cycle of defining an edge topic and assembling a mix of thought leaders to discuss emerging opportunities — such as ethics and AI. We get information from other affiliate programs at Stanford; with mediaX, we develop insights together. We use those insights to guide our internal work."***

Jeffrey Hancock, Professor of Communication and Founding Director of the Stanford Social Media Lab, became a frequent collaborator with mediaX.

"During my first year arriving at Stanford, Fred Turner, Byron Reeves and I got a small grant from mediaX to think about how technology changes the way we see time, and how it influences different social processes. Fred and Byron and I met once a week for two hours just thinking and talking, and it was absolutely delightful. We presented our insights from those conversations to a mediaX group of people from Stanford and from industry. That was really cool, and it produced a White Paper that really influenced the way I thought about things, even right up until now. I think it influenced the way that Byron thinks about Screenomics; and Fred and Byron now teach a class around the theme of time."

Kanji Uchino, at mediaX Global Innovation Leadership Workshop, 2016.

At the same time, many faculty members would like to understand who in the outside world might have an interest and application for their research and how to articulate its relevance.

> Jeremy Bailenson, Founding Director of Stanford's Virtual Human Interaction Lab, began interacting with mediaX as an Assistant Professor when he first arrived at Stanford University. He commented: ***"mediaX has taught me so much. First and foremost, it has helped me develop a skill to do basic academic research that also helps companies make products. It turns out to be possible to find common ground, where professors do the work they are passionate about and companies find a way to understand how that science can help them move forward. mediaX created an exploratory ecosystem where industry and faculty would come together in a spirit of creativity. There is no doubt that my hundreds of hours spent with mediaX staff, corporate members, and fellow professors have helped shape who I am as a researcher."***

Jeremy Bailenson presents "The Trials and Tribulations of Narrative in VR" at the mediaX 2016 Conference on Sensing and Tracking for 3D Narratives.

Orchestrate serendipitous connections across disciplines

The process of engagement was cyclical, and sometimes iterative, but generally proceeded in six phases:

1 In dialogue with the industry liaison or representative, mediaX identified Research Topics that aligned with the industry's interests, pain points and curiosities. Together the liaison and the relationship coordinator planned Themed Conversations, a benefit of membership at the Associate and Institutional levels. As multiple relationships developed over time, new Research Topics emerged from Themed Conversations and became inspiration for mediaX seminars, workshops, conferences or informal meetings.

2 Some, but not all, Topics which bridged corporate and academic interests, evolved into mediaX Research Themes. mediaX curated Research Themes by working with campus experts across disciplines. Topics provided starting points for conversations leading to the definition of Research Themes.

3 Once Research Themes had been determined, mediaX issued Requests for Proposals (RFPs) to invite responses from researchers on campus. In keeping with mediaX principles, RFPs favored interdisciplinary responses. Following feedback from industry members, mediaX assembled a small faculty review committee that evaluated the top proposals and chose Projects to receive seed funding.

Participants from the 2016 weeklong residential workshops with mediaX Members IBE-FGV and HKUST.

4 Dialogues between industry members and academic researchers who received Project funding were held regularly to share curiosities and insights emerging from the research.

5 Stanford researchers generally continued interacting with mediaX programs beyond their Projects — seminars, conferences and the like; meeting with other Stanford and industry researchers in pursuit of new intersections of mutual interest.

6 Often the research continued after expiration of the Project seed funding, sometimes pivoting with subsequent cycles of mediaX Research Themes and often receiving funding from other sources.

From the start the mediaX model of paid memberships created a self-supporting program, and member subscriptions provided the funds that supported mediaX activities and campus research in areas of interest to industry. In that way, funding provided energy to mediaX, as a catalyst, to encourage research, exploration and innovation that was relevant to industry. Throughout the process, mediaX oversaw the cultivation of relationships, the facilitation of interactions and processes — the internal transfer of funds from a pool of mediaX membership fees to the appropriate campus departments — and the sharing of insights from research results.

Interdisciplinarity, along with a bit of engineered serendipity, helped create the context for discovery.

Expect openness and respect

Openness and respect are essential for creating a space where no participant or idea is treated as trivial or off the wall, and everyone's perspective is valued. The resulting safe atmosphere allowed expansive creative thinking — whether from a musing or a well-developed inquiry.

> Nik Martelaro, Assistant Professor at Carnegie Mellon's Human-Computer Interaction Institute and formerly Stanford doctoral student with Larry Leifer, Professor of Mechanical Engineering and Director, Hasso Plattner Design Thinking Research Program: ***"The whole project, Making Noise Intentional, came out of a 'goofy idea' I had, thinking about how noisy robots are — and how the whole experience of being around robots in your house will be terrible if the motors sound bad. The idea was, 'Hey, we're going to have all these robots interacting with people and what are they going to sound like? Should we be thinking about the sound of those motors, the audio experience that someone is having?' mediaX was one of the first groups to support this. I don't know how else we could have gotten this project started without mediaX funding. mediaX sponsored work in which initial ideas weren't ready to be funded by a larger institution. What is so exciting about this project is that it has now actually spurred an entire line of work within the human robot interaction community."***

5 See Appendix 5: Membership Levels and Benefits

Carla Pugh, Professor of Surgery and Director of the Technology Enabled Clinical Improvement Center:

"Addressing problems that companies never believe they'd be able to solve, that's what Stanford and mediaX can bring to the table. It's problem-solving AND personalization, an approach and utilization of technology that industry can't do alone. Because it requires a transdisciplinary group of researchers to find that gold nugget, needle in the haystack, diamond in the rough, then combine them into one thing and then fuel the next product development, so that it's more human-centric and human-focused."

Nik Martelaro

Elizabeth Wilsey welcomes the mediaX community to the 2019 Conference on Digital Communities and the Augmented Human Experience.

An atmosphere of almost familial comfort arose from the insistence on intellectual and emotional safety. A personal and personalized approach, as well as a genuine desire to engage individuals in both academia and industry in a way that was respectful of each person's specific needs, was foundational in developing this supportive environment.

> ***"People in the mediaX member community referred to mediaX as 'family', providing them with a sense of 'home' and 'belonging' — which was particularly powerful given the interdisciplinary nature of the program,"*** said Elizabeth Wilsey, mediaX Director of Community Relations.

Corporate participants echoed this sentiment.

> Maria Frank-Kinslow interacted with mediaX for many years as a graduate student, working with Renate Fruchter, Director of the Project-Based Learning Lab, and then as an industry liaison at member company Genentech. Describing the atmosphere that mediaX cultivated, she observed: ***"Communication depends on the type of relationships that are built. mediaX engagements didn't feel as sterile as a conference, it wasn't a group of strangers sitting in a room; they were very intentional and felt more like friends and family. It's all about that sense of psychological safety and trust and feeling of 'we're a group of people that has come together to learn something from each other' versus 'we're experts in our companies and competitors'. As a female graduate student in an engineering field, that experience was powerful for me. Everyone's contributions were accepted, and that approach changed what people were willing to share, how they interacted with each other, how open they were to sharing, and also how open they were to listening."***

While it was important to foster openness, it was equally important to understand that certain protocols within academia and industry require discretion regarding proprietary material. Most industry interactions on Stanford research projects were assisted by mediaX relationship coordinators in order to assure courteous and respectful interactions for mutual benefit.

The ground rule for respect was explicitly communicated to both faculty and industry delegates and helped avoid either party twisting the thumb screws for off-the-record information or premature disclosures. A catalyst can quickly get a bad reputation for an introduction in which one party tries to take advantage of the relationship. The vetting and orientation of members favored participants with common sense as well as vision.

Boris de Ruyter describes Philips' engagement with the mediaX visiting scholar program at a mediaX 2013 Conference.

As Boris de Ruyter, Senior Research Director and Principal Scientist at Philips Research Eindhoven, recalled,

"Our leadership preached that innovation would be strengthened with 'outside-in', which means you can get new ideas by bringing outside people into your research with visits and conversations. Yet, we always understood that the exchange of information was intended to benefit both us and Stanford. You have to be willing to share and to show what you're working on. The more you can do that, the more you will get back. In preparing for our interactions with mediaX, I informed people about the topics, the project, or the research that I set up for the visit. I told them, for instance, that they should not talk about or be involved in topics for which we currently are filing patents. That's common sense. But other than that, we really did not make any limitations on the conversations because we always considered that the program was a gift technically and, in that sense, there was no need for a non-disclosure agreement around it. Some of our highest value in the mediaX engagement came from lab visits and the ensuing conversations — either at Stanford or in Eindhoven at Philips. We never asked for non-disclosure agreements, but we did let our presenters know they were not to talk to Stanford about anything with patent potential."

Coordinate across multiple time cycles

Academic researchers think in terms of years in the journey from exploration to publication. Industry, on the other hand, is often under pressure to demonstrate immediate value and return on investment.

"When the corporate world and the academic world overlap, there's a disruption in the timelines, because the corporate world moves at such a different pace and is so much more concerned with next quarter or this year's whatever or an 18-month product cycle. Getting the corporate entities to think in terms of 5 or 10 years out was something of a miracle, frankly. There was an intellectual generosity that was inherent in everything about mediaX — people's willingness and ability to be generous with thoughts and ideas, sharing them. The positive thinking of mediaX was infectious," commented Harlan Kennedy, Experience Design Strategy Consultant.

mediaX collaborations operated on multiple time frames. Short-term studies built on existing research skills, interests, and resources for goals that could be completed and reported within a year or less. Medium-term explorations leveraged current strengths for research goals that required additional resources and had completion time horizons of one to two years. Long-term collaborations leveraged current expertise with shared interests and ambitious goals. These often sought to redefine the research questions and objectives and required the research team to request additional skills or personnel as well as additional resources for a three-to-five-year time horizon.

John Willinsky, Professor of Education and Principal Investigator on two joint research projects inspired by mediaX members, shared his experience: ***"The impact was the opportunity to work with industry people, to get a different mindset, a different framework for research. We observed a different energy and intensity that drove industry in its goals, marketing, product development, and branding.*** ***That was really an eye opener in a number of different ways. It inspired the team and challenged the team and frustrated the team. It was a different way of working, with different goals, different objectives around the bottom line.*** ***The mediaX funding enabled us to talk with the industry researchers, and the collaboration was very fruitful. We made progress in our work; we had new standards that we borrowed from industry. The timelines and the intensity of insight needs were new for us."***

Find, vet and on-board paying corporate members aligned to catalyst principles

An organization with interest in Stanford research — either from having attended a lecture by a Stanford professor, or through a published article written by a Stanford scholar, or by word of mouth following a mediaX event — would connect with mediaX, in its role as the industry affiliate program of the Human Sciences and Technologies Advanced Research (H-STAR) Institute. In initial meetings with the interested corporate representative, mediaX vetted the corporate inquiries to see how they dovetailed with thematic areas of pragmatic application, such as Education, Commerce, Entertainment, and Wellness. In addition, organizations needed to embrace the principles of mediaX. These included consonance of their interests with research on campus; a willingness to embrace the respect and openness mediaX valued as essential to creativity; the cross-disciplinary outlook that helps drive innovation; a long-term approach to inquiry; and acceptance of the autonomy of the faculty researchers. Companies merely looking for information they could purchase cafeteria-style were referred to other appropriate Stanford programs.

John Willinsky describes Human AI Perspectives on Learning and Understanding at the 2017 mediaX Conference on Human AI Collaboration: A Dynamic Frontier.

Ryota Yamada shares perspectives on "Technology to Understand Humans" at the 2017 mediaX Conference, Sense-Making & Making Sense.

Ryota Yamada, who served as an industry liaison for OMRON for many years and was a Visiting Scholar several times with Communication Professor Cliff Nass, described how his internal company conditions, including the state of the business and the company's strategic focus, influenced his advocacy for renewed membership in mediaX: ***"The output of the collaboration was only one aspect of the value of the collaboration. Value can be found in a lot of different places. I found that a lot of unexpected value came from gaining new knowledge outside my area of expertise. When I shared this, it stimulated other activity inside OMRON. The mediaX relationship was most important when OMRON was working on human-machine collaborations and less so when OMRON prioritized technical or business issues. Sometimes the focus of the company's business and technical strategy changed. It is easier to explain the value of the collaboration when there is a project in place and one can talk about the output of the project. OMRON is a forward-thinking company, concerned with addressing social problems. Even for a company like this, when financial constraints get tight, it becomes more difficult to justify this activity. At the same time, focusing only on the short term isn't sustainable — it's very important to get information and knowledge from academia to help companies consider how to survive for a long time. The best corporate departments for collaboration with academics are R&D, new business development and innovation."***

Tee it up: How does a catalyst bring industry and academic researchers to the same table?

The alignment of industry concerns with academic research represents a critical process in industry-university relationships. Corporations must meet quarterly goals, time-to-market is key, and maintaining an edge is essential for competition. Academic research functions on a different timeline with different measures for outcomes. Given that much of early research is not immediately transferable to a product, it was imperative that industry members recognized the stage of research work emerging from seed grants. Results from the seed grants provided ideas many corporate researchers were often learning about for the first time.

Pair industry liaisons and university relationship coordinators

Each industry-university relationship was channeled through an industry liaison and a mediaX relationship coordinator. Once a company received an invitation to subscribe to a paid membership in mediaX, they were encouraged to select a liaison, usually a Chief Technology Officer or Research Lab Director at the corporation, and begin working with a mediaX relationship coordinator to establish a plan tailored for their membership. The membership decision often involved multiple parties in the corporation — a champion, a decision maker, and a finance approver (sometimes even a committee). The industry liaison communicated aspects of the organization's engagement with mediaX programs to these internal stakeholders as well as to appropriate internal scientific and technical personnel.

The communication bridges established by industry liaisons and the university relationship coordinators were essential to the function of the catalyst culture. The industry liaison communicated mediaX activities to people inside their organization, often identifying company employees for participation in Themed Conversations or conferences. The industry liaison also collaborated with the mediaX relationship coordinator to identify Topics of mutual interest and the timing of company engagements. Members' investments of time and travel resources for the liaison and for their employees amplified the benefits they received from membership.

> Hicham El Habti, President of Mohammed VI Polytechnic University (UM6P): ***"Thanks to the membership in mediaX, I have a much better understanding of how Stanford University works. mediaX served as a facilitator and matchmaker, identifying Stanford researchers interested in some of the problems UM6P researchers are working on and curating the introduction of relationships. One of the most important realizations was that it is important to assign a liaison from UM6P to work with mediaX, one who understands the mindset of UM6P researchers. The most important thing is that you spend time to facilitate and nurture the relationships that are developed."***

"Make sure there's the right internal sponsor for the liaison. The liaison must have high level and broad business support. For Xerox I was a right liaison because I was the Chief Innovation Officer. Broader internal support gives the company liaison a higher probability of success. The internal match of liaison and stakeholders is crucial. Getting a diversity of leaders involved is helpful because, if one person doesn't see immediate value, somebody else may say, 'Okay — I need this for my use case so let's keep supporting it.' mediaX was really good about understanding the particular business interests of member companies. They really tried to get deeper into understanding our vision — our pains and dreams — understanding what the business is all about, and also where we were trying to grow. Every time that I came to Stanford, the professors in our conversations were able to react to what I had shared with mediaX about our pains and dreams."

Sukanta Nag, Chief Technology Officer at OneTen, industry liaison with mediaX for both Xerox Learning and Prudential.

Kazumitsu Kamiya, Hiroshi Tomita and Ryota Yamada, mediaX 2019 member appreciation event.

Sukanta Nag

Member's objectives, topics of interest, and applicable member benefits were revisited annually, or more often if member priorities necessitated. This enabled updated assessments of member priorities and renewal of topical focus — both of which were key to supporting membership renewal. mediaX clarified communication channels, reporting patterns, and insight objectives at the beginning of each membership year. Clear statements of expectations, both for obligations and outcomes, enabled participants coming from different perspectives to be comfortable in their own roles, and to understand the parameters of others' contributions. Organizations that became members agreed to these expectations. As needed, the mediaX relationship coordinator provided support to affirm the value of the relationship to their corporate decision makers. To nurture the relationships, mediaX relationship coordinators communicated personally to industry liaisons, embraced the excitement of the member's interests and responded to the company liaison's rhythm of communication updates.

Frame industry inquiries to align with academic scholarly goals

In mediaX research interactions, proofs-of-concept and potential were the focus. It was essential to reframe industry questions into a form suited for academic contexts — broader than members' current pain points, open to possibilities that were not yet imagined, targeted to solutions that were often five to seven years into the future. The industry liaison, in collaboration with mediaX, championed these opportunities.

For example, during the second decade of the 21st Century, many companies became concerned about customers' trust in their products, services and brands. In academia, expertise in "trusts" may be found in legal or financial realms, but there was no formal department with faculty focused on "trust" as human perception. Nevertheless, Stanford research teams in medicine, social psychology, communications, political science, computer science, and symbolic systems were studying various aspects of presence, authenticity, belief systems, institutional reputation, deception, cognitive security, and visual associations that — together — provided new insights on trust for both academic and industry participants. Finding emergent interconnections on the concept of "trust" and integrating them into seminar and workshop programs contributed to solutions in both academic research and industry edge work.

> Professor Jeffrey Hancock, an expert on trust, reflected, ***"I learned a lot from speaking to mediaX groups, especially some from China. They asked different questions than I had heard before. Discussions about those differences changed the way I thought about trust in networks versus trust in institutions. That insight has influenced my subsequent work."***

"A presenting question from industry often had the flavor of, 'Will adding this product feature generate more sales?' or 'What's my competitor doing?' or 'What metric of success can I use to differentiate our products?' These types of questions would not have been appropriate for graduate student or postdoctoral research. Occasionally, such questions were interesting to faculty members and could be addressed in consulting relationships — outside of mediaX. However, more often, the creative challenge was to unpack the members' questions and identify threads of Stanford research from which questions could be asked to ignite additional research and then inspire industry to imagine answers to their questions."

Martha Russell,
mediaX Executive Director

Martha Russell opens the mediaX 2017 Conference on Workforce & Learning Pathways In A Period Of Dynamic Change.

Kenji Suzuki, presentation on "Imagining Alternatives with Immersive Engineering" at mediaX 2015 member appreciation event.

During the process of refining inquiries, the companies working with mediaX found themselves opening up to new possibilities in ways that they could transfer to their business colleagues.

> ***"New ideas and new ways of approaching design challenges, gained by AISIN's capable innovators through mediaX engagements, have augmented our internal innovation resources by connecting AISIN to new possibilities,"*** reflected Kenji Suzuki, Chief Digital Officer and Vice President of AISIN Corporation. ***"This has helped us see opportunities to grow our business."***

Corporate affiliates used insights from Stanford research projects, funded by their paid mediaX memberships, to strengthen cases they made to their Boards of Directors for taking a long view in terms of research horizons.

> Hiroshi Tomita, former President of Konica Minolta USA, one of mediaX's long term members, describes the importance of having the catalyst listen attentively and skillfully to the industry's needs, as well as the challenges and successes of working between industry and academia: ***"mediaX listened to our current challenge and future direction and developed a question that reflected our interests. It had to resonate for professors as well. We tried to find mutual areas of interest. At our company, we are always discussing things from our perspective — mediaX offered a different angle with fresh and interesting perspectives. We were able to extract key points from Stanford research that helped us to move forward. It is not easy to transfer academic research to product development. Only a small percentage of corporate research makes it to development — less than five percent. Creating the 'Stage Gate System,' [at Konica Minolta] with clear distinctions between stages, helped clarify the focus and set expectations for interactions with Stanford. The process was sometimes iterative,"*** Mr. Tomita added, and recommended that one individual from the company be involved as liaison in both the academic research and the core technology side. Based on his experience, having one person who understands both the corporate and the academic research processes and all the options — including the "paths not taken" that can be returned to for exploration later — was very helpful. ***"Working with Stanford provided the opportunity to observe proofs-of-concept: to test and verify the concepts related to our research. Based on those results, and feedback, our research teams were able to share insights with our Board of Directors."***

As relationships progressed through a series of informal and formal events that included updates to both university researchers and industry representatives, industry liaisons were often asked to report on their involvements with mediaX when they returned to their offices. Written summaries from mediaX recapped those engagements, helping corporate participants share information with key decision makers within their organizations. This reinforced the importance of being a member and supported membership renewals. And it activated a stream of new members learning about the program by word of mouth.

> ***"One of the best things I've learned from mediaX is this mindset of 'what we can do together that neither of us can do alone?' This has become part of the culture, not just of Sapiens Park, but also I take this for my life. I respect mediaX very much for this culture. That's why my company became a member, and also why I invited other organizations to become members. All the networking, all the events and the Theme Days, and the concept of questions that activate faculty projects — it really works."*** Marcelo Guimarães, Co-founder of Sapiens Science Park, Florianopolis, Brazil.

Engage university researchers with industry questions

The process of weaving together industry interests and academic pursuits took place through one-on-one conversations with faculty members — via email, office visits, cups of coffee, and campus walks. After unpacking industry insight objectives into questions that could be pursued in Stanford labs, mediaX initiated conversations to brief faculty members on industry pain points, questions and topics of interest, and invited them to speak to industry researchers about their current research through Themed Conversations, and at mediaX conferences, workshops, and seminars.

Marcelo Guimarães discusses "Approaches to Immersive Storytelling" at the mediaX 2016 Conference on Augmenting Personal Intelligence.

Jeremy Bailenson, Talia Weiss, Mrs. Dyalá Jiménez and Costa Rican President Mr. Carlos Alvarado visit the VHIL Lab.

These informal dialogues were a regular aspect of relationship development and maintenance; they conformed to the practices of sharing and open exchange that characterized the self-organized network of Stanford thought leaders. The topical threads that emerged were woven into Research Themes and framed as challenges. These challenges were discussed with members, then formalized into mediaX Requests for Proposals (RFPs) for seed grants to be funded from the fees paid by mediaX corporate members. mediaX invited all Stanford faculty members to submit proposals for "seed grants", and winning proposals received the grants.

> ***"The best opportunities for a faculty member are those that provide funding to start or extend research with their graduate students. A direct suggestion will most likely call out antibodies and result in rejection, but a catalyst and advocate can inspire them to think about new topics,"*** Martha Russell, mediaX Executive Director, advised. ***"Hence, mediaX focused on using provocative questions to inspire new ways of thinking. Project proposals had to be the faculty member's idea. The challenge was to find creative ways to facilitate their discovery of their stake in the question. mediaX helped transform industry concerns into questions that would entice Stanford scholars: 'Can your expertise address this challenge?'"***

Professors and graduate students eager for industry problems to give them a "real world" orientation to a research problem would submit proposals for the seed grants. Although Stanford professors often had many large grants already supporting their research, the mediaX seed grants provided direct links to industry interests, as well as the opportunity for a graduate student to explore a novel area. This approach was quite different from much of industry research, in which disciplined technology roadmaps guide research to generate, defend or extend business opportunities. It was also quite different from traditional academic funding, which usually requires a proven track record of success, support derived from large grants, and publications. Seed grants proved ideal for graduate students with creative ideas and were in amounts that could support graduate students' research for a summer term or for a full year.

mediaX recognized the challenges and hard work of conducting interdisciplinary research and supported intellectual plurality by bringing together researchers using different methods of inquiry, different exploratory methodologies, and different rationales for truth-seeking.

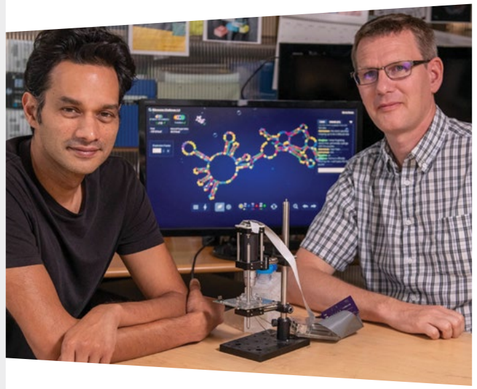
"Through the unfolding processes of interdisciplinary teams moving from research questions to emerging technological outcomes,… technologies-in-development mediate and embody interdisciplinarities, often irreducible to their antecedent parts, and also reflect relational tensions," reported Erin Young, Postdoctoral Research Fellow at The Alan Turing Institute and former Visiting Scholar with Roy Pea.

Straddling a variety of fields with a complex set of multidisciplinary interests gave mediaX the opportunity to spark and support inquiries beyond traditional disciplinary specialties. mediaX gave preference to grant applications that involved a cross-disciplinary approach and had the potential to significantly transform socio-technical systems.

Erin Young, panel on "Personalities for Socially Interactive Bots" at the mediaX 2018 Conference, Transparency and Trust in a World of Social Bots.

Rhiju Das, Associate Professor of Biochemistry at Stanford University School of Medicine, was a recipient of a mediaX seed grant. Professor Das' The Open Lab EteRNA project, inspired by the Research Theme on Measuring and Increasing the Productivity of Knowledge Workers, has crowd-sourced research in RNA nanotechnology with over a hundred thousand citizen scientists, integrating actual wet-lab feedback into a video game interface and revealing key socio-technical insights for remote knowledge workers.

"Trained as a particle physicist, I knew a fair amount about the molecular structure of RNA molecules but not so much about the social science aspects of crowdsourcing. Though the EteRNA Project was rooted in biochemistry, the mediaX seed grant enabled us to leverage insights in social science and successfully start the massive EteRNA Open Lab, which has empowered thousands of citizen scientists to innovate complex RNA designs for medicine."



Rhiju Das and Ingmar Riedel-Kruse, presentation to demonstrate Open Lab EteRNA project and Hybrid Tangible Interfaces for Learning following the mediaX 2014 Games and Learning Conference.

Full court press:
How do we streamline the catalyst role?

From the moment mediaX received an inquiry from industry, through the funding of seed grants and years of research, mediaX acted as catalyst with great diplomacy to translate the relevance of the research to various interests and to mediate myriad differences between participants — cultural norms; research timelines; scheduling meetings for participants in time zones around the world; objectives which often varied between industry and academic participants; and what was and was not proprietary in each realm. mediaX provided timely updates to maintain inspiration and assure the best interests of industry and academia as the engagements progressed.

In addition, a catalyst can accelerate an interaction by collecting and providing essential background information to meeting participants before activities take place. As faculty members are usually volunteering their scarce time resources for introductory meetings, mediaX sought to reduce the overhead of time required to prepare for and conduct meetings, whether at Stanford or at a member's location.

Byron Reeves, Professor of Communication, summarized the value of this in saying: ***"On the Faculty side there's so much hesitancy to be involved in industry conversations because of the overhead that's required, especially for visiting company locations — simple things like making schedules, exchanging money, all those things that require solving logistics issues."***

Balance policy compliance with creativity

Trust enables autonomy. mediaX learned the value of knowing the rules and also how to be creative within them. The program communicated the Stanford policies for affiliate programs to corporate members in order to ensure compliance with University regulations. Violations that garner administrative oversight can drain resources by triggering additional reporting and meeting requirements. The administrative services of H-STAR, the parent organization for mediaX, provided support and experienced guidance.

Additional support to industry members extended to assisting them in navigating their organization's requirements for processing membership approvals and payments, and describing their return on investment for participation. It was essential for affiliate program staff members to simultaneously manage differing priorities, events, and member benefits.

A network of positive-minded administrators in collaborating departments was essential in order to fully realize smooth operations.

"mediaX was an interesting and challenging program for the H-STAR administration. A balance between autonomy for mediaX and organizational structure protocols was continually addressed and negotiated by the mediaX Executive Director and the H-STAR Associate Director for Finance and Administration. The relationship flourished and continued to provide a successful operation."

Lilian Kamal, H-STAR
Associate Director for Finance
and Administration

John Seeley Brown described "Sense-making in our Post AlphaGo World" at the 2017 mediaX Conference on Sense-making and Making Sense.

"A primary task of program administration," commented Adelaide Dawes, mediaX Program Manager, ***"is 'to run interference,' and this has a very practical meaning. Academic institutions have administrative protocols that demand a thorough knowledge and understanding in order to navigate. Business organizations also have administrative protocols. Achieving a balance between both sets of administrative constraints is key to a successful relationship."***

Embrace opportunities to innovate

Attention is a critical currency in relationships. Sustaining faculty involvement and industry memberships required continually paying attention to their needs and their perceptions of value derived from their relationship with mediaX. Membership renewals and conference attendance were strong indicators of the value perceived by companies. Faculty members' voluntary participation in mediaX seminars and Themed Conversations provided evidence of their perceptions of value. Offering programs that sought to inform future directions required regular assessments of insight objectives from participants, as well as the more subtle signals from the wider environment.

The earnest desires of both Stanford and corporate researchers gave the early affiliates of mediaX their appetites for learning about each other's research questions and methods for obtaining insights.
To augment resources and build out the program, ambitious recruitment efforts expanded the membership roster with companies eager to get solutions to the rapid expansion of digital media and growing audience expectations of influencing content. Some problem-oriented members sought off-the-shelf solutions, and these expectations put stress on the collegial culture in which mediaX had developed.

Responding to the impact of changes in the economic and business climates on member acquisition and membership renewals, mediaX began a biannual audit with its stakeholders — faculty, members and prospective members. Conducted by an objective third party, feedback from these regular audits informed course corrections and pivots, such as redesigning the wordmark and reframing the positioning of mediaX at Stanford University, increased meeting frequency, wider community involvement, and more convenient packaging of insights for members to share with others in their organization.

The practice of re-thinking mediaX programs and learning together was particularly helpful during the COVID-19 pandemic, when the member benefits of being physically on Stanford's campus became inaccessible due to Stanford's concerns for community safety. mediaX pivoted from in-person seminars and conferences to remote-access events. By collaborating with a new member that had extensive know-how in virtual platforms, mediaX jointly developed its own virtual platform, mediaXploration, and provided opportunities to engage as a community in a virtual reality environment. Building on the agility of the mediaX staff team and the strengths of collaborators, opportunities for change were quickly identified and implemented with an experimental, can-do approach of "Always learning. Always ready for feedback."

"There was never a response that started with 'no'. For even the things that seemed impossible at first, we started with 'Let's explore that possibility'."

Jason Wilmot, mediaX Director of Communications and Events

Charles (Chuck) House, former Executive Director of mediaX, recalls how mediaX adapted to early challenges:

"Not long after I began, we hosted a mediaX Conference, 'our annual meeting' for member companies, featuring prominent research from Stanford faculty. It was, at best, moderately attended, and the consistent sponsor commentary was of the form, 'What have you done for us lately?' That launched a series of efforts to deepen our value proposition for members. Notable in this period was the decision to permit "on-campus" visiting scholars from member companies, particularly for international firms. We did this by creating a new Strategic membership category. This paid huge dividends for Philips Corporation, whose visitors included some employees doing PhD research in Eindhoven. It paid off for Konica-Minolta, who began to rotate key executives for short visting periods, which built support 'back home' in Japan, that had hitherto been difficult to obtain."

Ideas for program innovation came from member requests for types of interactions that they had heard of or experienced elsewhere. Receiving those requests in the spirit of innovation opportunities, mediaX continually refreshed its program offerings.

Stay lean and agile

From its beginning, the structure of mediaX programs was intended to be lean and nimble. The objective was not to create a bulky administrative organization. The goal was to create a catalyst function in which resources were directed to the benefit of the participants.

> *"To work on cutting edge problems, we had to be in sync with what's going on in the world,"* recalled Keith Devlin, Emeritus and Founding Executive Director of mediaX, ***"so we kept mediaX on a lean and nimble path. You need one or two people who are willing to make the program their career; this allows the executive director[6] to focus on bringing in funding or working with industry, while faculty can focus on research."***

Keith Devlin opening the 2019 mediaX Conference, Digital Communities and the Enhanced Human Experience.

6 See Appendix 9: Sample Job Announcement for Director of an Industry Affiliation Program

Streamlining and creating efficient, smooth-running interactions optimized the use of staff time as well as the time of all participants. Involvement and engagement were actively pursued in program activities, while decision groups — such as faculty review teams for the Research Themes — were designed to be small, ad hoc and fast-acting.

As Stanford's top administration shifted over the twenty-one years of mediaX, changes in the rules of engagement for affiliate programs required mediaX to update and reframe how programs and relationships were described and implemented. Changes in the local, international and global business climates brought about shifts in markets, finances and health that consequently influenced how membership opportunities and benefits were described, as well as how program activities were delivered.

> ***"Congratulations to all who have been involved with mediaX for the past twenty plus years! Who knew that when we started it, it would last so long?"***
> Sam Steinhardt, Assistant Vice President, Shared Services, University IT, and former mediaX Operations Director.

Staying lean and supple in its administrative structure allowed mediaX to adapt its catalyst role to changes in university policy, industry trends, and world events. mediaX nimbly weathered such events and continued in its role to energize research that benefitted both industry and academia.

Martha Russell,
Executive Director
of mediaX advised:

"Elaborate approval processes limit agility. Establishing standing committees for ongoing activities can devour the resources of a catalyst program and risks turning it into a bureaucracy. The 'two pizza rule' prevailed for all working groups established for mediaX planning and program implementation. This rule essentially advises the size of teams built for innovation, efficiency, and expedited decision cycles. It refers to the team being small enough to have a meal by sharing two pizzas. Groups that require more pizzas are likely to devolve to bureaucratic processes that encumber their speed and creativity."

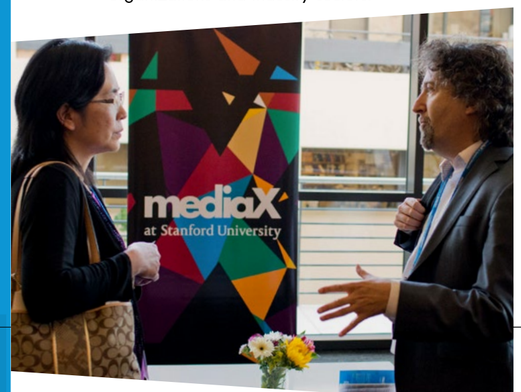
Maria Frank, Ben Vickery, Jason Wilmot and Rick Kennedy work together at the 2015 Global Innovation Leadership Program on Smart Workspaces.

The Virtuous Cycle of Mutual Benefit

"Mutual benefit implies positive outcomes as well as absence of harmful consequences. *Companies that have thrived in a membership with mediaX have had top executives who respected the uncertainty of truly novel research and appreciated the sustainable advantage of horizon views and new ways of thinking.* ***They were willing to participate in the give and take of intellectual exchange that focused on questions and insights, rather than solution-based answers, when energized by a sense of agency for the mutual benefit of both parties,"***

reflected mediaX Executive Director Martha Russell.

Conferences and seminars, including the 2014 mediaX Conference on Well-being & Productivity in a Globally Connected World, provided opportunities for informal conversations between people from diverse organizations and industry sectors.



It's a Team Sport

The Virtuous Cycle of Mutual Benefit

The hallmark and primary goal of mediaX was supporting research and discovery in a way benefitting both industry and academia. mediaX orchestrated an ongoing cycle that began with relationship-building, deepened and augmented those relationships through collaborations and, along the way, recognized intellectual achievements.

Always bring your "A" game:
How do we build relationships that support a multidisciplinary community?

Relationship-building conversations in large and small gatherings brought people together from multiple areas within and outside of their respective realms of academia and business. Working with creativity and diplomacy between the industry representatives and campus researchers, mediaX curated research topics of interest to both industry and academics and transformed these into Research Themes appropriate for university research. These Research Themes then generated Requests For Proposals for small seed grants that were sent to all Stanford faculty members. mediaX Research Themes attracted a university-wide community of researchers (see Figure 1, page 44) and multi-disciplinary participation (see Figure 2, page 45). After awarding the grants to selected Projects, mediaX facilitated seminars, workshops, conferences, and dialogues to allow corporate members to hear, and often interact with researchers. The research and ensuing discussions often generated insights that led to more research — at Stanford and also within corporate labs. Insights and activated applications of proofs of concept renewed and expanded the cycle of inquiry.

Roland Vogl, Executive Director of the "Science and Society" and CODEX programs at Stanford Law School, and recipient of a mediaX seed grant: ***"It's a dance. There's usually a mismatch at first. I am always learning from mediaX how that process works and how to really generate value in both sides of the relationship. You have two audiences — business executives and brilliant faculty. How do you have a model that translates faculty brilliance into something that is helpful and relevant for industry and is also valuable for faculty, doesn't distract them from their main research agenda, and provides resources to support grad students? The task is to get a corporate affiliate comfortable in understanding the role of university research, and to be excited about having a seat at the table and being part of those conversations."***

In the role of intermediary, mediaX fostered connections among people and across ideas. The goal of each connection was to spark synergy and enhance synchrony.

Build community with reciprocity

One of the catalytic experiences of a mediaX Research Theme was the practice of convening researchers from all the projects funded under that theme to hear about each other's work — with beginning, midpoint, and end-of-project updates. Often, mediaX members attended and engaged in these small group discussions, usually held on campus — and on Zoom throughout the COVID-19 pandemic — with the understanding that the research itself was ongoing, not yet published and still in flux. These interdisciplinary interactions fostered personal connections that allowed for creative thinking. Listening to the reports of the other researchers who were addressing the same challenge, yet often in different ways, generated both inspiration and opportunities for future collaborations.

Neema Moraveji, Founder of SPIRE, leader of the Calming Technology Lab at Stanford University and former doctoral student with Roy Pea, Professor of Education & Learning Sciences

"My project dealt with the quality of attention for the knowledge workers of the future, especially in the context of stress and data/information overload. Giving presentations to mediaX corporate members acted as a forcing function to help me prepare ideas on the knowledge-worker neurophysiology perspective. mediaX members were coming to Stanford to get ideas for the future, and this was a new idea. And they were open; for them it resonated. One of the big benefits I got from mediaX is that it wasn't just an academic lab — our dialogues were industry-focused. It's easy to be in either academia or industry, but it's hard to build a bridge or to be the bridge between them. mediaX was able to do both."

Neema Moraveji discusses insights on "Personal Feedback for Self-Regulation" at the mediaX 2014 Conference on Well-being and Productivity in a Globally Connected World.

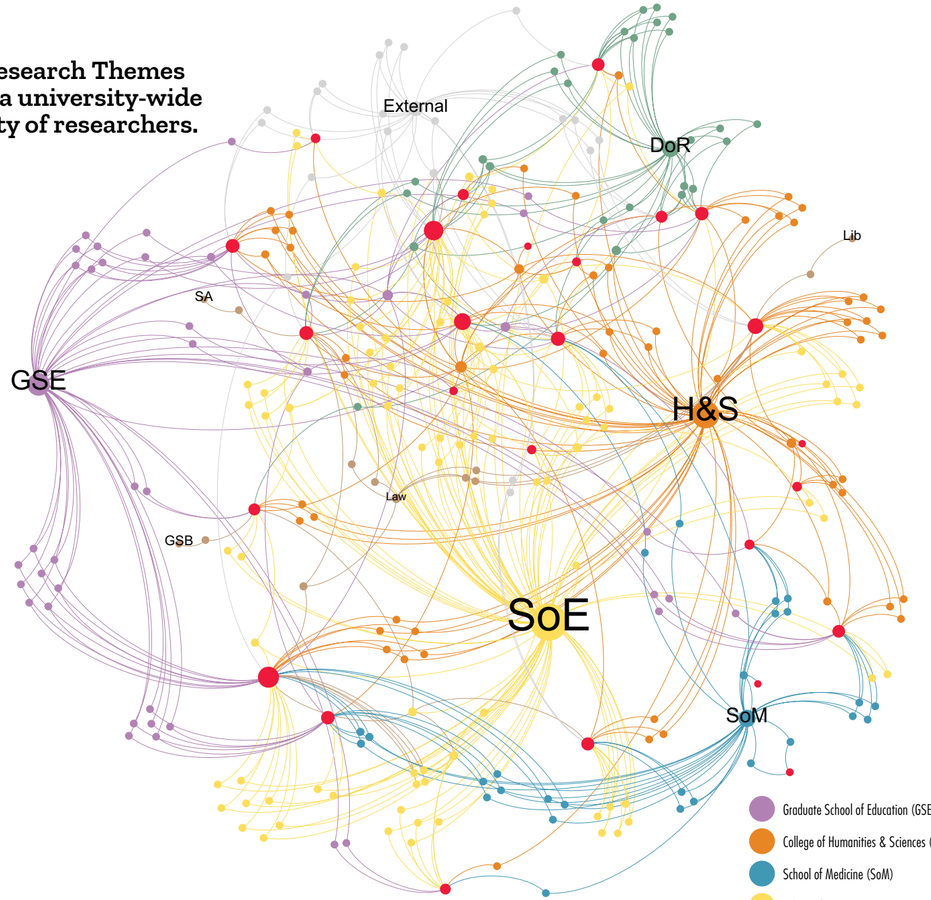
Nilam Ram, Professor in the Departments of Psychology and Communication: ***"The big impact of the mediaX Research Themes for me has been the long-term contacts on campus. For instance, I now have a shared student and two shared grant proposals with Nick Haber, Assistant Professor, Graduate School of Education, who also got mediaX funding. We met in a meeting with corporate members. We did a joint lab meeting, my team presented some stuff, his people presented some stuff. And then from there, we found common ground and started moving forward. We wrote a proposal to the Human-Centered Artificial Intelligence program, and that process went really well. Then we invited him to be a co-investigator on a National Institutes of Health grant proposal we're putting in next month. And the cooperation is going to be a long-term relationship with lots of benefits for both of us."***

Visionary business leaders saw the value of cordial relationship-building and in certain contexts valued it as much as the academic output itself.

Boris de Ruyter, Senior Research Director at Philips Research Eindhoven, described how the value proposition of the Philips engagement with mediaX evolved through information sharing, leading to a multi-year, multiple visiting scholar engagement between faculty at Stanford and Eindhoven Technical University (ETU), Philips researchers, and a cohort of promising Philips scientists who were pursuing PhD degrees at ETU: ***"One approach we customarily used to evaluate the impact of our Visiting Scholars at Stanford was very informal and based on a bit of feedback from the project coordinator and the product leader in terms of how strong the contribution was. On one visit our vice president, Fred Boekhurst, observed how well the Stanford students and our employees were integrated and said, 'Look, this is really working.' He was not looking at the academic output but was seeing the powerful engagement and interaction. Now we are more likely to evaluate collaborations in terms of the multiplying effect of collaboration relationships — the potential to create a network of relationships for knowledge sharing. We now create micro projects, accompanied by workshops and discussions, all focused on building a network around the main topic."***

Inspirational relational benefits have continued to be leveraged by industry partners years later. And in fact, as Boris de Ruyter pointed out, he often invited those former Visiting Scholars to give seminars for his internal research teams.

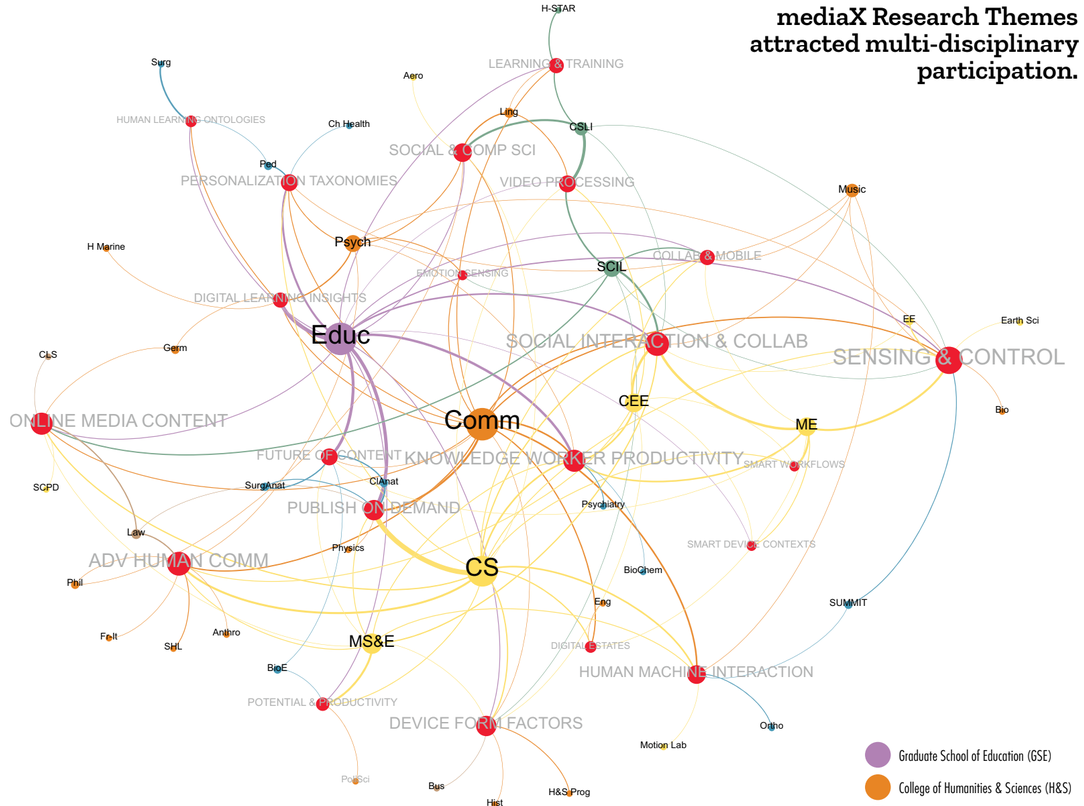
mediaX Research Themes attracted a university-wide community of researchers.



- Graduate School of Education (GSE)
- College of Humanities & Sciences (H&S)
- School of Medicine (SoM)
- School of Engineering (SoE)
- Stanford organizational units (DoR): CLSI, SCIL, SCPD, H-STAR, CLS
- Various: Law, Business (GSB), Library, etc.
- External
- mediaX Research Themes

Figure 1: mediaX Research Themes attracted a university-wide community of researchers.
By funding projects under Research Themes inspired by member interests, mediaX attracted a university-wide participation of Principal Investigators.
This Network Graph shows the collegiate home of Principal Investigators receiving funding for projects under mediaX Research Themes.
The size of each Collegiate node indicates the number of mediaX projects funded for Principal Investigators in that College.
The size of each Research Theme node (red) shows the number of projects funded by mediaX under that Research Theme.
Thicker edges indicate more projects.
Appendix 7 describes mediaX Research themes and Projects. Appendix 8 identifies Researchers and their Departments.
Network Graph created by Neil Rubens, using Gephi.

mediaX Research Themes attracted multi-disciplinary participation.



- Graduate School of Education (GSE)
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- Various: Law, Business (GSB), Library, etc.
- External
- mediaX Research Themes

Figure 2: mediaX Research Themes attracted multi-disciplinary participation.
This Network Graph shows the relationship between projects funded under mediaX Research Themes nodes (red) and the home departments of faculty receiving project funding.
Department nodes are in the color of their collegiate unit.
The size of each Departmental node indicates the number of mediaX projects funded for faculty Principal Investigators in that Department.
The size of each Research Theme node shows the aggregate number of projects funded by mediaX under that Research Theme.
Thicker edges denote more projects.
Appendix 7 describes mediaX Research themes and Projects. Appendix 8 identifies Researchers and their Departments.
Network Graph created by Neil Rubens, using Gephi.

Davis Masten, mediaX Distinguished Visiting Scholar, Founder of Cheskin Research and Chairman of the Board of Quantified Self Labs: ***"mediaX Conferences often took place in the days following TED. I regularly attended TED for many years and went from those to the mediaX Conferences. At TED I learned the latest about what had happened in many fields. At mediaX Conferences, I learned what the future might hold. At one mediaX conference I sat next to speaker and mediaX Distinguished Visiting Scholar Gary Wolf, who had just started a movement called 'Quantified Self.' Fast forward through several conversations and opportunities to help each other to the role I now play in his company, Quantified Self Labs."***

Stretch thinking to reframe ideas

Throughout many cycles of collaboration with corporate members and Stanford researchers, mediaX strived to cultivate both the discipline and discovery that characterizes creative inquiry. In the initial stages of the collaboration, when mediaX contacted Stanford researchers working in areas of interest to industry in order to frame questions for the RFPs, both corporate members and researchers remarked on how the process stretched their thinking. Similar results emerged from meetings with researchers in different disciplines working on the same Research Theme, in Themed Conversations and Workshops, and in updates that gave participants with common interests the chance to discuss, question, and gain insights. Upon completion of projects, results were usually formalized into publications, parlayed into additional research proposals or resources, woven into other research projects, and helped students earn their degrees.

Renate Fruchter, Founding Director of Stanford's Project-Based Learning Lab in Civil and Environmental Engineering, shared, ***"With every project and every new connection with different industry partners who brought their needs and pain points to the table, we asked the next round of questions. And this was very exciting, because it provided continuous stimulation for our research students. Every completed research cycle was a launch pad for the next cycle."***

Thiago Ramos dos Santos, Head of Pharma Informatics UK, Canada, Northern Europe at Roche and formerly Director for International Partnerships for the instructional arm of the Brazilian National Transportation Industry Association, SEST SENAT:

"The engagement with mediaX helped the leadership team at SEST SENAT to develop a vision and establish an end goal that allowed us to come together to start planning. Our objectives were not crystal clear initially. Engaging with mediaX and learning about the advantages of user-centered design not only taught us the methodolgy but also helped to create our vision. Through mediaX interactions, people made changes in their personal thought processes. By changing how a question was asked — "reframing" — an entirely new set of questions could be formed. By using a different analytical model, new results and insights could be harvested."

Neil Jacobstein, Thiago Ramos dos Santos and Roy Pea at the 2018 SEST SENAT Workshop on Innovation and Training for Brazil's Transportation Infrastructure.

Renate Fruchter discussing Augmenting Team Intelligence and Performance at the 2016 mediaX Conference.

mediaX Themed Conversations were created through a close collaboration between members and mediaX. mediaX worked iteratively with the member to explore new perspectives, adaptable methodologies and potential topical adjacencies, in order to select a multidisciplinary Theme and to assemble combinations of Stanford and industry researchers to respond to the questions at the heart of the Theme. The topical intersections usually included an element of surprise as a wild card. This process was embedded in mediaX's goal of providing possibilities for eye-opening, thought-provoking experiences that might trigger a new perspective, lens or thinking model.

Boris de Ruyter, Senior Research Director at Philips Research Eindhoven, recollected: ***"At Philips, we have a cycle of "innovation briefs", which are documents created by a team that scouts a certain topic from many different angles and works with our IP department to create a landscape for us on the topic, with respect to the trends and knowledge. The insights we got from our Themed Conversations were channeled into our innovation briefs. What we always had at the end of a Themed Conversation was a component of this strategic document. When we came to Stanford, we were actually looking for unexpected answers. So, in that sense, whatever people would say was relevant. Because we were concerned that we were limited in thinking from our own perspective and therefore wanted to get reactions from other people, we looked for feedback which might be even completely outside of what we could consider an answer to our question. On one Themed Conversation I was concerned that a presentation on AI automation in automobiles might not be relevant to our business in health care systems. On the flight back to Holland, the team hardly stopped talking about the applicability of that presentation for our planning. The element of surprise was very, very important in the Themed Conversations."***

Industry participants learned that the mediaX virtuous cycle could map onto their own organizations. Experienced corporate members concurrently implemented similar virtuous cycles of inquiry and insight among their research teams.

Stephen Su, Vice President and Director of the Industrial Economics & Knowledge Center of the Industrial Technology and Research Institute of Taiwan (ITRI): ***"Over the years of our membership in mediaX, I worked with my team to create a systematic method to bring back insights from the Themed Conversations or Workshops. Stanford has a group of very brilliant professors, and we accelerated our learning at ITRI through that type of engagement. This year we mobilized a lot of people at ITRI in talking about potential topics with mediaX, and ITRI researchers have continued those discussions with some new initiatives. Insights from our interaction with Stanford have become input to the strategic direction of seed funds that our organization uses to stimulate interdisciplinary collaboration in new areas. The most powerful benefits we received from our membership have been due to mind-opening and insightful moments that changed decisions for our research methodology. We also realized many benefits from our preparations for the engagements."***

Stanford researchers also internalized the cycle of relationship-building, facilitation, and recognition to gain new insights and start a new cycle. The enormous value of these exchanges was difficult to quantify — in either industry or academic contexts. Without a doubt, they delivered benefits that motivated repeat engagements.

Michael Shanks, Professor of Classics, Program Leader for Stanford's Foresight and Design Innovation Group and frequent mediaX workshop facilitator: ***"In and around the toolkit of design foresight, we use hindsight, with insight into where we are at the moment, to create a view to strategic foresight. Historical patterns can be recognized but rarely repeated exactly. People with agency, with creativity, with a vision, can build different futures. It's how we tell stories to ourselves, to others. It comes out of juxtaposing things that are not connected and seeing the fascinating possibilities of connecting them. In my mind, mediaX has always stood for cycles of pragmatic transdisciplinary experimentation."***

Ioana Baeda unwraps trends "From Groups to Communities" at the mediaX 2019 Conference on Digital Communities and the Augmented Human Experience.

Marcelo Guimarães, Tamara Carleton, Neil Jacobstein, Michael Shanks, Martha Russell, Greg Nuyens, Raquel Coelho, preparing for the 2017 workshop on "Human Sciences and Information Technologies for Innovation and Training for Brazil's Transportation Infrastructure" in Brasília, Brazil.

Energize with new people and ideas

Topics around the intellectual curiosities that brought mediaX scholars and practitioners together evolved. The goal of understanding how people use digital media, and how new information technologies could be better designed by more deeply understanding the people that use them, remained the North Star of dialogues and inquiry for a continuing cohort of Stanford faculty members and industry leaders. Their familiarity with each other's expertise grew over time, and they formed a hub in the mediaX network, which was energized by new people and new ideas and grew across Stanford departments and colleges and expanded around the world with global corporate leaders.

The mediaX cast of characters also included people with occasional involvements — featured keynote speakers, cameo panel participants, and graduate students and postdoctoral assistants who contributed their passion for discovery, then migrated to other organizations after receiving their degrees. mediaX also attracted occasional contributors from the greater Stanford and Silicon Valley communities — innovation practitioners, independent inventors, startups, corporate scouts, professional developers, entrepreneurs, and advocates for various aspects of human-machine interaction. The community of mediaX extended even more broadly, involving former members and collaborators in each of these categories, as well as those who shared mediaX's thematic interests by attending a conference or seminar. As programs evolved, participants themselves became catalysts. This network was wide and inclusive and repeatedly demonstrated itself as a hallmark of mediaX.

The Visiting Scholar option for mediaX members was a popular way for industry to connect more closely with a Stanford research network. When member organizations sponsored employees as Visiting Scholars to spend time at Stanford University, it was for periods ranging from several weeks to several years. To accomplish this, mediaX worked with a relevant academic faculty member on campus. After the Stanford faculty member agreed to host the study plan of the industry guest, mediaX issued an invitation to the Visiting Scholar's employer. In such cases, mediaX and its H-STAR administrative team then worked as needed with the appropriate administrative offices on campus to obtain a visa for the Visiting Scholar and to matriculate the industry guest as a temporary member of Stanford University. Following academic convention, the Scholar's home company continued to pay the employee's salary and expenses during their visit at Stanford.

Stephen Su, Vice President and Director IEK, ITRI: ***"My organization does market research and monitors trends for future technologies for five overseas offices in addition to the institute in Taiwan. We help talented industries become a critical part of the global ecosystem in innovation. The help comes in many forms; we are constantly changing and adapting. Interdisciplinary collaboration is a key area that the whole organization is eager to enhance. There are many values that we have learned from mediaX throughout the years of the engagement. One year we went to a mediaX event and heard a presentation on aging from Professor Abby King which described how elderly people could use a digital tablet to capture experiences. At ITRI we were talking about elderly topics and how to incentivize walking for seniors. After that engagement, we explored the cultural differences between the US and Taiwan and the difficulties of using a tablet while walking. Lo and behold, several months later Pokemon Go came out and became very popular in Taiwan and other parts of the world. We learned from mediaX that cultures are influential on behaviors and also that avatars can be used remotely to triage needs before interaction with specialists becomes needed. After that, we sent three visiting scholars to Stanford, and the experience changed the thinking of our technology researchers."***

Andrea Stevenson Won describes results of research using video capture to determine roles in teamwork in "Measuring and Increasing the Productivity of Knowledge Workers".

Martha Russell, Alex Peng and Stephen Su at the mediaX 2014 Member Appreciation Event.

Andrea Stevenson Won, Assistant Professor at Cornell University and former doctoral student with Jeremy Bailenson:

"I often think back to the experience of working with a Konica Minolta Visiting Scholar on research in my early days of grad school. He came into the lab to look at a demo for a project on nonverbal behavior, rapport, and synchrony and he asked: 'Have you thought about asking subjects about their degree of acquaintanceship to the person they're interacting with?' It was very relevant because, in fact, there was research to suggest that matters. The greater impact on my work was that this question came from the context of industry due diligence, and that frame of reference continues to influence my research."

Researchers from member organizations who matriculated as Stanford Visiting Scholars gained the opportunity to affiliate with a faculty member, focus on an area of study, and learn first-hand the mediaX culture of Stanford in the heart of Silicon Valley. While length of stay varied, the recommended minimum amount of time spent as a Visiting Scholar was six months, with added value for time spent beyond that. This enabled the Visiting Scholar three months to learn the landscape of the University and then three months to contribute. Stanford faculty and students benefited from a regular exchange of business perspectives on research questions and the potential applications of results. At the discretion of the hosting faculty, Visiting Scholars sometimes participated as a member of the host faculty's research team.

Some Visiting Scholars limited their interactions to one or two individuals; others networked across the University to establish a wide range of new relationships for novel ideas. Relationships established at Stanford through mediaX's programs often led to a fruitful experience on campus and provided the Visiting Scholars with new knowledge and personal growth that they were able to leverage for their careers and their organizations.

Toshiya Okamura, Senior Researcher at the Institute of Energy Economics Japan and former mediaX industry liaison and Visiting Scholar, described how experiences as a Visiting Scholar tuned in to his needs at different stages in his career: ***"mediaX has been the best of my supporters for a decade. From the early days, mediaX took an interest in my responsibilities and what I was doing. More recently, my responsibility — my challenges — have been very broad. I have had challenges about how to make the Tokyo Gas Company more innovative and how energy institutes could work more rapidly and more concertedly toward carbon neutrality. mediaX helped show me how I could look at and approach the problem. When I was not sure about the problem, and I was working with something abstract, mediaX gave me information from different angles to help me realize the direction or the views I could take."***

Interactions with Visiting Scholars also stimulated and enriched faculty and student experiences at Stanford. Characteristic of the reciprocity that guided the relationships cultivated by mediaX, researchers also gained new perspectives from their interactions with the Visiting Scholars.

Keep the ball rolling: How do we facilitate the exploration of new ideas?

The bywords for successful facilitation of dialogue between industry and academia were "diplomacy", "delicacy", and "patience" — grafted onto attentive listening. As projects proceeded, mediaX supported a variety of exchanges in thoughtfully facilitated conversations. These encounters began with introductions that included the exchange of professional backgrounds, research interests, and opportunities for mutual benefit. mediaX identified people in its business and academic communities with shared interests and collaboration potential. Following introductions, cultivation activities included presentations and familiarization with challenges and questions of mutual interest. Through robust discussions, participants identified how their research interests aligned, discussed the strengths of their labs, and explored new opportunities for shared scholarly interests.

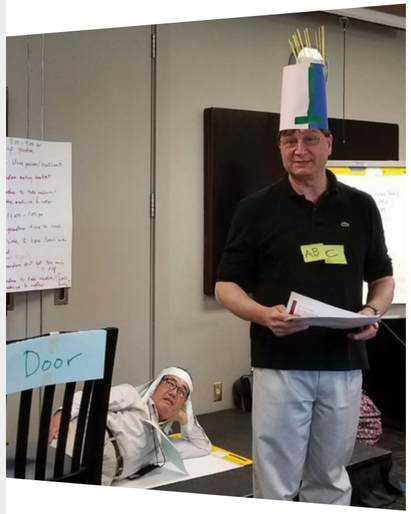
"The way to align faculty and industry agendas was to focus on something that was bigger than any of them, and that became the question. The questions built the community, those two together led to a quality of conversations that really made mediaX unique." Karina Alexanyan, mediaX Postdoctoral Scholar and Member Benefits Manager.

Avoid group-think

A goal of mediaX engagements was to stretch beyond the obvious and pull people just enough out of their research comfort zone to encourage creativity and exploration. Valuing participants and their ideas was paramount.

Yasunori Kimura, executive technology leader formerly with mediaX member Fujitsu, and currently principal fellow to mediaX member, Japanese Science and Technology Agency (JST) as well as several Japanese universities, commented on the catalyst impact of mediaX to inspire both content and process:

"Scientific leaders in Japanese organizations are relatively conservative to change compared to the US. Many of the Japanese universities and government organizations are mainly focused on domestic issues and do not know much about what universities in the United States are doing. When I was introduced to mediaX, I saw an opportunity to broaden the mindset of Japanese researchers. To be honest, I didn't expect a drastic change. However, with reciprocal research presentations between Stanford and Japanese scholars, some of the young Japanese researchers reframed their scientific directions. The JST research leaders gained confidence in those directions and, eventually, sent a visiting scholar to Stanford to collaborate on brain computing. That collaboration has been valuable to the organization as well as to the researchers."



Saadi Lahlou leads the 2018 mediaX member workshop on Design of Intelligent Agents as Co-workers. Yasunori Kimura acts the role of software user.

Creating a respectful meeting space allowed participants with doubts or objections to voice those concerns, rather than allowing misgivings to go "underground" and possibly surface at a later date to impede research.

Benjamin Babcock, UX Research Leader at Meta AI: ***"Psychological safety occurs when you feel a sense of safety in those moments of learning, exploring, and knowledge gathering, and the mediaX engagements created those moments for us. Groupthink can set in; you think you've figured it out, but bringing in another set of perspectives can help you say, 'Wait a minute, we're holding to our ideas too early and too firmly, and we need to explore more.' mediaX helped us approach some of our big ambiguous research questions from a different point of view."***

Find common language

mediaX attracted participants from five continents and locales ranging from Morocco to New Zealand, Brazil to China, Silicon Valley to Italy, Netherlands to Taiwan and others. While participant diversity enriched discussions and encouraged parties to think in new ways, attention to comfort levels across cultures required careful event planning and attention to details such as sensitivity to position hierarchy in Japan and the social importance of long lunch breaks in Brazil. English was the common denominator for communication — most of the time. Occasionally, translators participated actively to facilitate rapid exchange. In all cases, mediaX ensured that discussions included opportunities for interaction and feedback to assure understanding.

However, English was merely the first step to finding common language. The language used in business and academic research can vary widely, making it challenging to communicate objectives and work collaboratively. Conversations between industry members and campus thought leaders, as well as conversations across disciplines, often start with differing terminology, methodology, and tools. Effective translation — even within a single language — requires understanding the intentions and priorities of each party and sharing ideas in a familiar language, as shown in Figure 3, page 54 and Figure 4, page 55.

Themed Conversations

Figure 3: Themed Conversations
This word art reflects the 100 words most frequently used in topics of interest to mediaX industry Members, based on the titles of the Themed Conversations hosted by mediaX 2001-2022. Topics for these conversations were developed with industry members and featured day-long engagements with relevant Stanford researchers. Larger words were more frequently used. Colors are randomly assigned.

Research Projects

Figure 4: Research Projects
This word art derives from the 100 words most frequently used in the titles of research proposals funded by mediaX 2001-2022 under 21 Research Themes. The titles of the 121 seed projects funded by mediaX reflect the Stanford response to industry interests. Larger words were more frequently used. Colors are randomly assigned.

Carla Pugh, Professor of Surgery, received a mediaX seed grant while a graduate student and then again when she joined the Stanford faculty. She shared her perspectives on reconnecting with the culture of mediaX. ***"The three of us presented to one of the mediaX supporters and I remember saying, 'Wow! There it is again, even in the convening of three mediaX researchers. Our work is so different from each other, what we're working on, what our research questions are. But once we had described our projects to each other and to the company representatives joining the dialogue, you could see this common theme come out of it. It had to do with establishing a language that helps to link the human experience with technology, with what technology has to offer. When the three of us finished our talks, what was most exciting was the conversation, the panel discussion that we had afterwards."***

Jeffrey Hancock, Professor of Communication, commented on how mediaX served as a "translation school" for academics to expand opportunities for sharing their research, and its relevance, with industry: ***"The biggest thing that helped me was learning how to speak to people from business, especially people from other cultures. It was almost like a translation school for me. I remember being in Tokyo and I saw Byron give a talk and it was like, 'Wow, that's how you talk to industry!' He could translate his intellectual ideas into exciting business language. That was eye-opening and from then on, I've always tried to hang out with Byron whenever he's around non-academics because it's just amazing. When I first started working with mediaX, Martha would help translate my work to the business community and that helped cue me about how I could talk about this or what I should talk about. Like "folk theory" has the word "theory" in it. I was told that the word "theory" scares business people.' But Martha said, 'It's okay. You just have to explain it in concrete terms,' and she would do that by example. So, for me the biggest thing I have gained has been to talk across boundaries."***

Graduate students who worked with Stanford faculty on mediaX supported projects have noted the extent to which mediaX involvement impacted their professional development — especially in terms of being encouraged to speak to a wide range of audiences — including academics within their department, researchers in other disciplines across the university, and industry partners.

Carla Pugh presents recent results from studies on Ontologies for Human Learning.

Nik Martelaro, Assistant Professor at Carnegie Mellon and formerly Stanford doctoral student with Larry Leifer, Professor of Mechanical Engineering:

"There was something special in the way that mediaX brought people together and let them be creative and just get together and talk about ideas and let those ideas be kind of frothy. ***I didn't realize until later that that's quite a unique experience that was provided to me by being a part of mediaX. It helped me to develop as a researcher, to learn how to speak to industry, to deliver content in a way that was meaningful."***

"Technology improvements, like design, are beset with values. Designer intent and user behaviors are frequently mismatched. Working on important problems requires working at cross-disciplinary boundaries. Our arguments about what constitutes an important problem should themselves generate insights about how we view our work and the prospects for its utilization."

Roy Pea, Professor of Education & Learning Sciences and mediaX Faculty Director

In many cases, the uniqueness of this inclusivity and exposure became apparent only after graduate students left Stanford to join other academic institutions and mentor new talent themselves.

Listen attentively for opportunities to provide support

Finding a common language was just one part of effective facilitation. Assembling cross-disciplinary participants required understanding the research needs of all parties.

"The support from mediaX for the Interactive Media and Games Seminar Series was terrific," recalled Ingmar Riedel-Kruse, Associate Professor Department of Molecular and Cellular Biology at the University of Arizona and formerly Assistant Professor of Bioengineering at Stanford. ***"mediaX believed in the potential of an ongoing seminar on the art and science of games — open for the wider community as well as Stanford. The seminars were a huge kaleidoscope of people in terms of personality, recognition and expertise. What we learned in these seminars also helped us to refine our cloud labs for educational engagement in biology experimentations — a Project that was also generously supported by a mediaX seed grant. Seminars and cloud labs also contributed to our understanding of how remote students and knowledge workers can collaborate."***

Corporate members' motivations for participating in mediaX varied. Insight objectives sometimes focused on a core technology or significant human-machine interface. Occasionally, the motive was to give employees from siloed business units an opportunity to establish common ground for future thinking. The curation of member experiences, based on listening deeply, allowed industry members to channel into their work the insights and energy they derived from mediaX events.

Ann Bamesberger, Workplace Advisor at Co3 Group, Ltd, who championed mediaX membership at both Sun Microsystems and Genentech recalled: ***"mediaX was this phenomenal learning club, where you know you've learned something to bring back real-time to your work environment and figure out how to apply it. Companies are either trying to make money or save money — that's fundamental. So insights at the work-group level, and in terms of work-practice, were a valued academic contribution. I could take my internal clients to Stanford for a mediaX event and change their thinking, enabling them to make decisions based on a shared perspective that evolved from the Stanford insights."***

Martha Russell, Ann Bamesberger and Rolf Kloeckner at the 2017 mediaX Conference on Sensing and Sense-Making.

University researchers and industry members each benefitted from new perspectives and insights that carried forward into their research and outcomes.

Exposure to industry and listening to their perspectives enabled progress in human-computer interaction research, a core area of interest to mediaX since its founding.

Associate Professor of Computer Science and Director of Stanford's Human Computer Interaction Program, Michael Bernstein, explained: ***"University research wants to sit in Pasteur's Quadrant (See Figure 5) — it wants to be deep, basic research, and also useful. To be useful, it needs to be inspired by real problems. It's so easy as a professor or as a graduate student to solve the problems that you see around you, at arm's length within the university environment and to make assumptions, and those are dangerous assumptions. The questions that get asked betray our mistaken assumptions about how teams or industry really work. So being in touch with a much, much broader set of stakeholders is critical to making sure that what we're doing is solving real problems. The enthusiasm we received from industry folks gave us a sense of whether or not we're on the right track. When we had them in conversation, it was a real way to make sure that we were considering the real impact of our results. In the end, human computer interaction research needs to be mutually intelligible to researchers and users."***

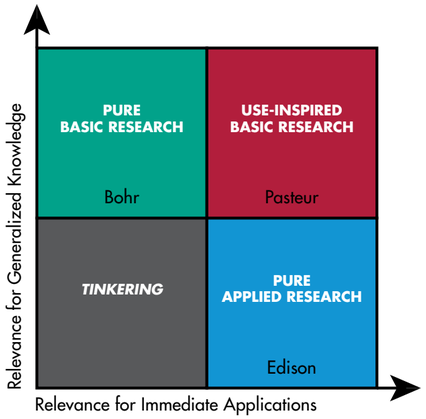


Figure 5: Pasteur's Quadrant
A thinking model that describes fundamental yet use-inspired research, Pasteur's Quadrant references the type of studies Louis Pasteur did a century ago, which laid the foundations of microbiology. Stokes, Donald E. (1997) Pasteur's Quadrant: Basic Science and Technological Innovation. Brookings Institution.

Nilam Ram, Professor of Psychology and Communication, remembered:

"I was really curious about what kinds of questions were being asked in industry and how they go about doing the research in order to solve the questions they're after. Through mediaX, I got to see the inner workings of a company and how their teams were formulating questions for their research. I could see how their teams and questions evolved, and it was not what I expected. I developed a better understanding of where my research fit within the context of what they were trying to do. It forced me to think about the problem in a different way. And that was helpful for some of the research projects we're doing now. The conversations helped me imagine other papers that we could write and alternative ways we could look at our data — opportunities that had not been on our radar before."

Weina Wang acting out her role as an AI Agent at the 2018 member workshop Design of Intelligent Agents as Co-workers.

Not surprisingly, the new perspectives worked both ways; industry participants gained insights from the researchers as well. Membership in mediaX allowed companies to review research that stimulated new lines of thinking and business opportunities.

Weina Wang, CEO of the Guangzhou Qitian Technology Company, a mediaX member, described the evolution of her company's internal agenda items based on research from Stanford: ***"Sometimes, we need to do something, but we don't know how to do it, or even don't know what's our goal, we just want to do something. When we received information from mediaX, we knew that there was research in an area of interest. So, we read the research and got inspired from the research to understand new possibilities about what we could do. In 2020, we began collaborating on projects tackling the diagnosis of Autism Spectrum Disorder and new ways to do therapy. This led to our receiving funding from investors for related projects. mediaX let us be aware of what's going on, and then we knew how to use the insights to solve our current problems. Also, mediaX introduced us to the Stanford's Center to Support Excellence in Teaching, with which we're collaborating on an innovative school concept."***

Effective facilitation also recognizes that dissonance can open dialogues that deliver new insights. Advance conversations and preparation enabled understanding where these mismatches might have interrupted progress and allowed mediaX, as faciliator, to bring them to the surface in ways that promoted effective dialogue rather than dismissal.

For Stanford researchers, a key benefit of industry-university interaction was the opportunity to test the relevance of their questions and insights against real world problems and be inspired about opportunities to apply insights from their research. Key business benefits of interacting with academic researchers were the inspiration to think differently, the dialogues that sharpen critical thinking, and insights that suggest new opportunities.

Enable serendipity

mediaX became known at Stanford for its support of innovative, interdisciplinary, experimental, and exploratory ideas, as well as for championing new ideas that benefited from a strategic, timely nudge. Leaders with whom mediaX worked, in both industry and academia, were precisely the individuals who found value in exploratory, creative, and outside-the-box thinking, evidenced by their appetites for novel perspectives. The virtuous cycles themselves created opportunities for serendipitous occurences. Even within well-planned programs and activities, the unexpected can be encouraged by welcoming the perspectives that each participant brings to the table — and in any given time and context.

The trust and confidence of the faculty advisors for mediaX and its industry champions were essential to encourage explorations into new insights and unknown territories. In practical terms, in order to enable serendipity, mediaX organized workshops with academics and industry members, initiated meetings between researchers from different departments working on the same theme, sponsored seminar series in which various participants from industry or academia presented on a common theme of interest. Conferences featuring speakers who were thought leaders in both industry and academia were open to the public as well as to members and researchers, and mediaX facilitated conversations between small groups of industry members and researchers on a variety of topics of mutual interest.

The relationship-grounded environment of mediaX encouraged conversations and connections, building a constellation of people who enjoyed the intellectual stimulation of finding similar or adjoining interests, often resulting in innovative research.

Ram Rajagopal, Associate Professor of Civil and Environmental Engineering, described how a mediaX encounter inspired an "Aha!" moment that changed his approach to both his research and how he teaches:

"I began thinking about my expertise in a new way when I was invited as a faculty expert to a mediaX workshop with the Brazilian Transportation Agency. The focus was the transformation of the training infrastructure for Brazil's transportation industry. As I began thinking about how to present my expertise on the design and operation of large-scale infrastructure systems, I realized the critical skills needed were data analytics and decision-making. It made me think about what I could share beyond my specific domain. The whole data-thinking, systems-thinking, and decision-making emphasis that I now teach to Stanford's civil engineering students started there. Through the mediaX engagement, the model became crisp and clear. After that experience, I incorporated data-thinking into an engineering class, which I later taught for the Graduate School of Business, and now some of those students have started companies based on that thinking. That was an amazing experience for me personally. It got me thinking in a new way: I hadn't considered how to present my work to a broader audience, and now I do that all the time."

Manish Saggar discusses The Neuroscience of Creativity at the mediaX 2014 Conference on Well-being & Productivity in a Globally Connected World.

Manish Saggar, Assistant Professor of Psychiatry and Behavioral Sciences, met Malte Jung, Associate Professor in Information Science at Cornell University, when they were both post-doctoral researchers at Stanford. Saggar was working with Allan Reiss, Professor of Psychiatry and Behavioral Sciences and Director of the Center for Interdisciplinary Brain Sciences Research, while Jung was collaborating with Cliff Nass, Professor of Communication. They discussed the research to explore enhancing creativity that Jung, Nass and Reiss had underway, and they had the idea to image multiple people's brains synchronously. Says Saggar: ***"We were chatting about how to extend this approach to more than one person — it becomes more interesting when you can scan the brains of multiple people at the same time and look at them simultaneously, looking for synchrony when people become more creative and more collaborative. We had some cool ideas but no money. A few months later, Malte contacted me and said, 'We have mediaX funding for the project Cliff initiated with Allan.' The idea was to somehow use multiple brain scanners at Stanford, connect them, measure people as they do some interesting collaboration together, and see where the brains synchronize when they do it well. I was thinking, 'This is one of the craziest ideas I've ever done,' because I had to sync up 3D scanners across Stanford and create an experiment that people could do while lying in the scanner and enable them to see each other's screens. But in that sleep-deprived, completely crazy state of mind, we ended up collecting data from 36 brains. The results helped us see patterns in new ways and gave me real outlier points that helped me earn an NIH Kangaroo Award that has provided $1.5M unrestricted funding for innovative research that goes 'beyond out-of-the-box'."***

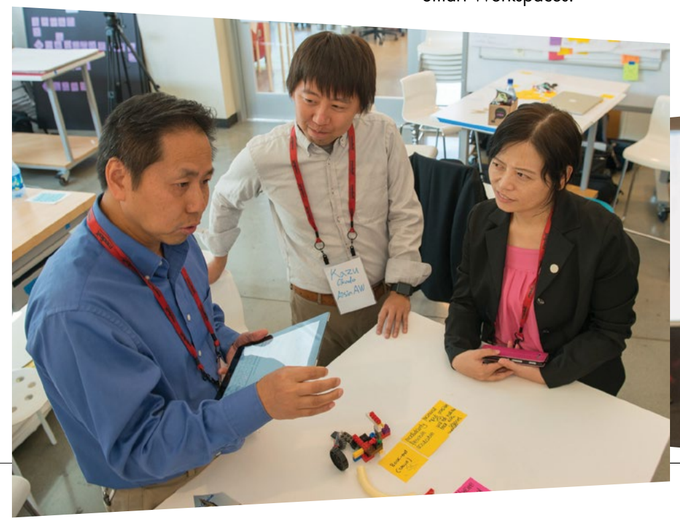
Exploration is a foundational element for discovery and for sprouting new lines of research. Support for exploratory work is difficult to find in an academic setting and was unusual, at the time, for an industry-supported organization. In this sense, mediaX embodied a foundational element for innovation in Silicon Valley: a willingness to explore boldly, which is often seen as risky in academic and business spheres.

Professor of Pediatrics and Director of the Pediatric Innovation Lab, Dennis Wall, described the mediaX ethos as a ***"willingness to take risks, be daring, bold, embracing visionary but still half baked concepts and ideas. The mediaX network has been instrumental in helping me make connections. It's huge, diverse and totally empowering. They go cross disciplinary, which is so important, bridging all these different disciplines and creating opportunities to work in concert on important problems. The mediaX Research Theme on 'Taxonomies for Personalization and Differentiation in Special Needs Learning'… the title alone inspires innovative thinking… connected me to the Transforming Learning Accelerator program, which has prompted collaborations with the Graduate School of Education. Our conversations and networking opportunities will help shape a new generation of innovative digital mobile solutions for precision child health and education."***

The vitality of the mediaX community was largely due to the breadth and variety of its participants. The community spirit of intellectual generosity enabled agile responsiveness to new questions as they arose, providing strength of expertise to address the continually changing cutting edge of innovation with mediaX participants who came from five continents.

Rajiv Ball, Partner at THNK School of Creative Leadership and Lecturer at Haas School of Business, University of California, Berkeley: ***"Diversity and inclusion made the mediaX programs effective. For innovation and creativity, you need diversity and a safe space. Participants [in mediaX Global Innovation Leadership Workshops] came to mediaX from all over the world, and there was a diversity in participants and in facilitators. And on top of it all a welcoming presence, creating a space where it was safe to contribute and safe to explore."***

Haisong Gu, Kazu Okodo and Yu-Yi Chen working together at the mediaX 2015 Global Innovation Leadership Program on Smart Workspaces.



Score a hat trick:
How do we recognize accomplishments?

mediaX recognized that the work required from collaborators — reaching beyond the comfort zones of interacting with their usual colleagues, stepping beyond their usual research methods, using new language in a routine way — was hard. Therefore, consistently and intentionally, mediaX took every opportunity to recognize the struggles and successes during each point in the engagement cycle. This recognition took many forms.

Send bouquets of relevant insights and appreciate efforts

A relationship catalyst maintains both regular and occasional relationships; both are essential ingredients. Regular relationships provide structure; occasional relationships provide variety and renewed vitality. Staying in touch with busy people required offering interactions that were relevant to them. Consistently doing so led to better understanding their interests, which helped to identify meaningful interactions, which encouraged their receptivity to requests.

Jeff Hancock discusses "How Trust Influences Communities" at the mediaX 2019 Conference on Digital Communities and the Augmented Human Experience.

As Professor of Communication Jeffrey Hancock reflected: ***"Over time I came to realize that mediaX always created an environment with the appropriate kind of people and with an appropriate sort of framing — people who were really engaged and curious and pushing ideas around. I'm very much into sharing ideas, but not in one-way experiences where you're just getting brain drain or feel like you're being used to give a company some inside information without an exchange of ideas. I never felt that with mediaX meetings, so I came to differentiate mediaX requests from almost all the other ones. mediaX only put me in rooms where there were sincere connections to be made. I would often think: 'Okay, I have no idea how this is going to go,' and it always went well, with exciting conversations and lots of enthusiastic sharing."***

Through a shoutout in a meeting or a compliment in an email, mediaX let members of its community know that their successes were visible and important to the program. An email version of a "high-five" to faculty members upon release of a new book or paper, a promotion, the listing of a new course, all served to affirm the catalyst's interest in their success. On a regular basis, mediaX relationship coordinators emailed "insight bouquets" to corporate liaisons, bundling timely information about mediaX with links to recently published papers, summaries of recent activities, links to recently available seminar video recordings, and other types of information that were particularly relevant to their company's insight objectives. These communications recognized the members' interests as well as accomplishments at Stanford. Additionally, mediaX conferences, seminars, and conversations among collaborators provided opportunities to verbally recognize exploits and acknowledge participants' efforts and accomplishments. Of course, public acknowledgements were timed to an individual's readiness for public exposure.

Turn failures into stories of learning

Consistent with the growth mindset perspectives of Professor of Psychology and (Courtesy) Education Carol Dweck, acknowledgement of effort can be equally or more influential than praise for accomplishment. The Silicon Valley respect for learning from failures is consistent with her philosophy of a mindset for growth. The culture of Silicon Valley reveres entrepreneurial effort and appreciates the positive value of discovering what does not work in order to better understand what will work. The catalytic activities of mediaX reflected this readiness to innovate, receptiveness to feedback and open acknowledgement of lessons learned. The "How Fascinating" gesture embodied this.

Adelaide Dawes, mediaX Program Manager and mediaXploration host:

"The spirit of exploration and discovery was central to the mediaX mindset. Trying new things required the anticipation of the unexpected. ***We recognized that many in the mediaX community had not yet experienced interacting in a virtual world, so we hosted a personal orientation for every registrant to our immersive virtual world. Event attendees were clearly informed of the experimental nature of the first event. In initial uses of mediaXploration we encountered technical difficulties, and we faced other problems. In each circumstance, we framed our engagement and use of the platform as a learning opportunity.*** *mediaX's clear communication that we were always learning and eager for feedback removed some of the pressure for perfection, introduced a sense of shared discovery, enabled greater freedom for risk-taking in our activities, and led to academic and industry authors collaborating on a fascinating paper about the experience."*

mediaX 2016 Global Innovation Leadership Workshop participants demonstrate the "How Fascinating" gesture at the conclusion of the workshop.

The "How Fascinating" gesture was a double-handed "high-five" accompanied by eye contact and the statement, "How Fascinating!" It represented the celebration of something learned from an error. The well-known "high-five" gesture, practiced around the world, requires two individuals who each extend an open hand to each other and allow their hands to give an audible "CLAP". The "How Fascinating" gesture doubles that. Two individuals each extend two open hands to each other and give a double "CLAP". The error and the lesson learned are verbalized and acknowledged. An easily-repeatable practice, it was utilized by mediaX staff as well as collaborators and members who participated in the annual mediaX Global Innovation Leadership Workshops. With the "How Fascinating" gesture, mistakes were not only accepted but celebrated as opportunities for learning. This encouraged ownership of mistakes and engendered a desire to improve, rather than to discount or breeze past problems. The communal and positive response also modeled the benefits of a supportive environment — key for the risk-taking needed for experimentation and innovation.

Especially when new program formats were introduced, mediaX emphasized the spirit of learning together. For example, collaborating with a new member having extensive know-how in virtual platforms, mediaX jointly developed its own virtual platform, mediaXploration, to provide opportunities to engage as a community in a virtual reality environment. Quickly building and deploying the virtual world required agility, a can-do attitude, an acceptance of risk, and an open acknowledgement of the activity's experimental nature.

Pass along the credit for success

Visiting Scholars sometimes shared anecdotes about the challenges of transplanting insights from Stanford into the cultures of their companies. After returning to their companies, to keep the memories of the mediaX culture fresh, many continued dialogues with colleagues in the mediaX community. By sharing experiences they had encountered when importing insights from academic research into their corporate business environments, they supported each other in creating change. The ripple effect from the Visiting Scholar's experience sometimes reached the Board of Directors of the host company and influenced a change of corporate policy or direction.

Lisa Natsume, Inside Sales & Market Development Manager, Energy Products at Tesla Japan, formerly at mediaX member Tokyo Gas Company, described the impact of her time at Stanford as a Visiting Scholar: ***"Being matriculated at Stanford University gave me access to new information. A big aspect of my work involved new communication tools for Tokyo Gas Company's consumer outreach. The company's Board had not wanted to use social media. They thought it was risky, and too informal for a conservative company. Things I learned through mediaX helped me show to my Board the value of using interactive communications; their approval of that was a big step for our company. Engaging with Stanford University helped me get valuable and high-quality information efficiently — and ensured the quality of that information."***

Quantitative measures of success have been used by some industry-university programs — numbers of meetings, attendees, etc. While these metrics do measure activities, sustainable results are more nuanced and do not easily lend themselves to numerical counts. mediaX did not seek to count, claim or take credit for the accomplishments of either its university or corporate associates. Corporations' abilities to allocate time and money to university interactions to inspire their internal innovation were derived from their own prior accomplishments. They were responsible for enhancements to that success.

Former Director of Stanford's Center for Design Research and now Associate Professor at Cornell Tech, Wendy Ju noted that some of her current research is rooted in her experiences with mediaX.

"I'm studying cross-cultural differences, and this work is inspired by my work with Japanese companies through mediaX, realizing, 'Ah, x some research assumptions here that are really interesting.' My early work with AISIN and mediaX led to thinking about how we can design for other cultures, and the need to learn about other cultures in order to be able to do this. It's still having an impact on my work."

BJ Hilberts, facilitating the 2015 mediaX Global Innovation Leadership Workshop on "Technology-Mediated Experiences for Human Interaction".

The greater opportunity for mediaX lay in offering generous and visible compliments to associates on their successful achievements. While credit was never sought, compliments were frequently received — and always returned.

Following mediaX's 2019 Global Innovation Leadership Workshop, Berend-Jan Hilberts, Executive Coach and former Dean of THNK School of Creative Leadership, a frequent collaborator on mediaX workshops shared: ***"I feel very privileged and grateful for being in the fortunate circumstances of contributing to the wonderful programs we conduct together at Stanford. It is always very rewarding for us to experience the impact we can make on participants. This group turned out to be very exciting to work with for us in part because of the challenge. We jointly overcame the initial challenges from culture and language with shifts and learnings, insights and introspections that took place during the program. It felt like a true co-creative effort between all in the room. Very much looking forward to our next opportunities to work together!"***

mediaX helped connect Stanford insights with a receptive outside audience, and vice versa, through a philosophy of collaboration that, like a virtuous cycle, empowered and enhanced as it repeated predictable steps. This roadmap for productive and sustainable collaborations depended on mutual respect and reciprocal benefit of collaborators.

Professor of Education John Willinsky reflected, ***"There is no secret sauce, there is only a small group of administrators with a can-do spirit, dedicated to reducing bureaucratic roadblocks and maximizing resources offered to researchers. Anyone using this Playbook will only go so far without hiring and collaborating with the right team."***

Pass the Torch

Pass the Torch

mediaX always kept in mind Co-founder and Professor of Communication Byron Reeves' concerns about the "many companies who were building stuff that had tremendous potential to influence terrible things and wonderful things all at the same time" and focused on opportunities to mitigate the terrible and promote the wonderful.

Natasa Milic Frayling, CEO of Intact Digital and former mediaX Distinguished Visiting Scholar shared: ***"This holistic aspect of mediaX looking at multiple perspectives is absolutely key to getting better design and giving back to the right people. It wasn't just, 'Here's a look at the technology.' It was about bringing in experts from multiple areas to look at complex issues, such as identity, and the meaning of identity in a digital world, and how digital assets form a digital estate, as a valuable asset for the lifetime of that individual."***

Professor James Fishkin, Communication Professor and Director of the Center for Deliberative Democracy, was a collaborator on two different sponsored research projects facilitated through mediaX and H-STAR.

"mediaX has been a fabulous interdisciplinary collaborative for fostering dialogue across the university, with people in the university and outside of the university, and conceptualizing new initiatives and innovation."

Mutual benefits developed from trust and respect, and from nurturing reciprocity, sharing and dual agency. Member organizations leveraged the benefits of their mediaX membership to create open innovative research environments in their companies, validate permission to be creative, and adapt insights to confirm or redirect their technology roadmaps.

"mediaX was an intellectual community that was always sparking each other's interests through mutual exploration. With a genuine desire to enrich thinking and leave the world a better place, mediaX stayed humble and open. Together we were all continually teaching and learning." Elizabeth Wilsey, mediaX Director of Community Relations.

Benefits received by Stanford University included capacity-building resources, such as inspiration for new research questions and funding for graduate students (and a handful of startups created by graduating students). Stanford's benefits also included reputational strength for excellence and leadership in

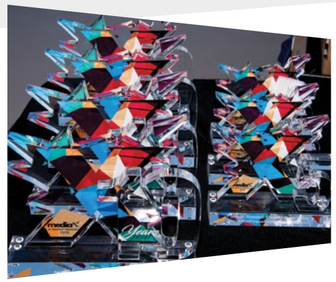
how improved human understanding assists in the development of new digital technologies and how new digital tools can enhance the human experience.

As Professor of Mechanical Engineering Allison Okamura explained: ***"The uniqueness of mediaX was its level of personalization in connecting faculty to particular companies so that each can understand the other better and then tailor opportunities for collaboration and funding."***

At this high-water mark of mediaX's more than twenty year legacy, many Stanford programs have embraced the core values of technology used to enhance the human experience, of purpose-driven open innovation, and of collaboration based on reciprocity. The mediaX vision has developed both roots and wings. Throughout its various stages, mediaX has always had champions, both in industry and in academia. They have been essential as mediaX navigated its role and the opportunities it could catalyze. To each of them, thank you. In the context of this success, the right time has come to encourage new emergent initiatives to take the spotlight as they establish themselves.

On March 31, 2022, the H-STAR Institute and mediaX at Stanford University ceased formal operations, making its legacy as a catalyst for discovery relationships available to interested communities on and off campus. World-class research derives from world-class questions. Catalyzing the questions for future research and framing the questions for optimum impact has been a key operating principle for mediaX. Through interviews and discussions, mediaX stakeholders have shared their insights on what might be the next Questions for the Future.[7] These mediaX resources are intended to be shared widely as the next generation of questions for our future comes into view.

Toshiya Okamura, former mediaX member liaison and Visiting Scholar from Tokyo Gas Company reflects: ***"When I first opened the mediaX doors, I was expecting 'media' as a conventional word, like marketing media or a communication technique. mediaX has boldly explored the expansion of 'new media.' Even in 2007, mediaX was already talking about digital tech's dark side, like AI's bias, which is still not widely recognized by industry people in 2022. mediaX has continually pivoted its programs to today-tomorrow issues, actively changing the 'media' context, always consistent with its mission and goals. mediaX always gave us 'psychological safety' to ask questions and to explore. With mediaX, I gained an understanding that it is OK to not understand everything when I share my insights. Especially in this fast-changing digital world, today's right decision may not be right tomorrow. When I heard about the closing of the mediaX program, I was sad, of course, but I also thought, 'OK, mediaX is teaching us that even an organizational form should go through evolutions, leaving its DNA in many mediaX members for now.' I and other mediaX members will help new generations learn in the same approach as we learned from mediaX.***



mediaX awards for Discovery Collaborations.

7 See Appendix 6: Questions for the Future

Image Credit: Linda A. Cicero / Stanford News Service

Many Thanks

Knock It Out Of The Park:
Many Thanks

Many thanks to the generosity of time and intellect from people in the mediaX community who contributed their wisdom and memories to this Playbook and, of course, to the greater mediaX community that energized and sustained the program.

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Ann Bamesberger, Workplace Advisor at Co3 Group, Ltd., former champion of mediaX membership at both Sun Microsystems and Genentech

Michael Bernstein, Associate Professor of Computer Science and Director of Stanford's Human Computer Interaction Program

Bruce Cahan, mediaX Distinguished Visiting Scholar, Adjunct Professor Stanford University and Founder/CEO Urban Logic

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Maria Frank-Kinslow, Senior Consultant in Organizational Effectiveness at Slalom, former Program Manager of Prototypes in Workplace Effectiveness at Genentech, mediaX member liaison for Genentech and former doctoral student with Renate Fruchter

Renate Fruchter, Senior Research Engineer and Founding Director of Stanford's Project-Based Learning Lab in Civil in the Department of Environmental Engineering

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Charles (Chuck) House, CEO of InnovaScapes Institute and former Executive Director of mediaX

Tatsuro Ichihara, Former Technology Executive at OMRON

Neil Jacobstein, mediaX Distinguished Visiting Scholar and Chair of the AI and Robotics Track at Singularity University

Dyalá Jiménez, Minister of Foreign Trade, Republic of Costa Rica

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Malte Jung, Associate Professor in Information Science at Cornell University and former doctoral student with Cliff Nass in Communication, and Wendy Ju in Mechanical Engineering Design, and post-doctoral scholar with Stanford's Center for Work, Technology, & Organization

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Harlan Kennedy, Experience Design Strategy Consultant

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Natasa Milic Frayling, CEO of Intact Digital and mediaX Distinguished Visiting Scholar

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Sukanta Nag, Chief Technology Officer at OneTen, former member liaison with mediaX for both Xerox Learning and Prudential Financial

Cliff Nass, Professor of Communication and (Courtesy) of Computer Science, Education, Law, and Sociology and Director of the Communication between Humans and Interactive Media (CHiMe) Lab

Lisa Natsume, Inside Sales & Market Development Manager, Energy Products at Tesla Japan, former Manager at mediaX member Tokyo Gas Company and Visiting Scholar

Peter Norvig, mediaX Distinguished Visiting Scholar, Distinguished Education Fellow at Stanford's Human-Centered Artificial Intelligence Institute and Researcher at Google, Inc.

Greg Nuyens, mediaX Distinguished Visiting Scholar and CTO TuneUp

Allison Okamura, Professor of Mechanical Engineering and (Courtesy) Computer Science

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Roy Pea, David Jacks Professor of Education & Learning Sciences at Stanford Graduate School of Education and (Courtesy) of Computer Science, Faculty Director of mediaX, Co-founder and Director of H-STAR Institute

Brian Pierce, mediaX Distinguished Visiting Scholar and Visiting Research Scholar at the University of Maryland

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Ram Rajagopal, Associate Professor of Civil and Environmental Engineering and (Courtesy) Electrical Engineering and Faculty Director of Stanford's Global Projects Center

Nilam Ram, Professor in the Departments of Psychology and Communication

Vignesh Ramachandran, Editor, *The Washington Post*

Byron Reeves, Paul C. Edwards Professor of Communication and (Courtesy) of Education and Senior Fellow at Stanford's Precourt Institute for Energy

Allan Reiss, Howard C. Robbins Professor of Psychiatry and Behavioral Sciences and of Radiology and Director of Stanford's Center for Interdisciplinary Brain Sciences Research

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Weina Wang, CEO of the Guangzhou QiTian Technology Company

Talia Weiss, Lab Manager, Virtual Human Interaction Lab

John Willinsky, Khosla Family Professor and Associate Dean for Student Affairs in Stanford's Graduate School of Education

Jason Wilmot, mediaX Director of Communications and Events

Elizabeth Wilsey, mediaX Director of Community Relations

Esther Wozcicki, mediaX Distinguished Visiting Scholar and Vice Chair, Creative Commons Advisory Board and Co-founder TractLearning

Ryota Yamada, Distinguished Specialist of Technology at OMRON, mediaX member liaison and former Visiting Scholar with Cliff Nass

Erin Young, Postdoctoral Research Fellow at The Alan Turing Institute and former Visiting Scholar with Roy Pea

Appendices

Image Credit: Andrew Brodhead

APPENDIX 1
Emergence and Evolution

mediaX at Stanford University and the H-STAR Institute 2001-2022

For more than two decades, the mediaX program at Stanford University served to pose and explore questions arising from the development and implementation of high bandwidth internet services and related products. In pursuing these questions, mediaX created innovative links between experts in industry and academics, contributing to improved productivity, creativity, and leadership in both sectors.

Origins of mediaX

Founded in 2001, mediaX at Stanford University originated from a mutually beneficial collaboration on social intelligence of machines between Tatsuro Ichihara, former Vice President of OMRON, and the co-authors of *The Media Equation*, Professors Byron Reeves and Cliff Nass. It took inspiration from the research agenda for high bandwidth communication (IPV6 protocols) in the social sciences, created at the 1999 Internet2 Socio-Technical Summit (I2ST), held at the University of Michigan and led by Dr. Martha Russell, interdisciplinary industry-academic program veteran then at the University of Texas at Austin. Reeves served on the planning committee for this Summit; he and Charles (Chuck) House (at Intel at that time) delivered keynote addresses.

Provost Etchemendy endorses mediaX as cross-campus interdisciplinary program

Championed by Philosophy Professor John Etchemendy (Stanford Provost at that time), who envisioned a cross-campus interdisciplinary program under the administration of the Dean of Research, Charles Kruger, mediaX came into existence in 2001. It began as an industry affiliate program of the Center for the Study of Language and Information (CSLI), expanding the original outreach mission established earlier by Philosophy Professor John Perry. Communication Professor Byron Reeves, Director of CSLI, became the Founding Faculty Director of mediaX at Stanford University, and Mathematician and CSLI Research Scholar, Dr. Keith Devlin, became the first Executive Director. Under their leadership, mediaX broadened the linguistics focus of CSLI's affiliate program to include humanities, cognitive science, media, and computer science, with outreach to companies exploring human interaction with digital devices and socio-technical systems. Industry memberships grew from founding member OMRON to include companies in Japan and the US.

H-STAR Institute is created with mediaX as its affiliate program

In 2001, Roy Pea came from SRI International's Center for Technology in Learning to Stanford University as a Professor in the Graduate School of Education. He brought with him a portfolio of research and industry relationships and established the Stanford Center for Innovations in Learning (SCIL), which introduced to Stanford University a research agenda on technologies related to human learning sciences. The shared corporate interests of mediaX and SCIL were acknowledged as Byron Reeves and Roy Pea became Faculty Co-Directors of mediaX in 2002.

Incorporating educational technology into its research focus, mediaX expanded its intellectual scope, prompting Pea and Reeves to create the Human Sciences and Technologies Advanced Research (H-STAR) Institute as the academic umbrella for mediaX and SCIL. mediaX moved outside CSLI and into H-STAR. Focal interests for industry affiliates of mediaX were identified as education, entertainment, and commerce; and a competitive seed grant program was created to attract Stanford researchers to problems about the thoughtful human uses of information technologies of interest to mediaX members.

To allow faculty attention to be devoted to academic responsibilities, Keith Devlin accepted the role of Executive Director of H-STAR, and Dr. Ellen Levy, Stanford PhD in Cognitive Psychology, became Executive Director of mediaX. During this period mediaX membership grew to include legacy and innovative media companies, primarily in the US and Japan, eager to understand the impact of the Internet on their content development and dissemination of products and services. Under the direction of Dr. Levy, engagements of mediaX programs with the Silicon Valley venture community intensified, and following her interests in new ventures, Dr. Levy joined the early crew of Linkedin.com.

During its first decade H-STAR established a strong program of Visiting Scholars

In the Visiting Scholars program, promising young investigators came for a year of affiliation with a Stanford faculty member; international visitors came from Scotland, Finland, Denmark, and Japan to follow Stanford intellectual pursuits and immerse themselves in the Stanford/Silicon Valley culture.

As foreseen by the I2ST Summit, collaboration technologies began to capture interest as one of the most compelling applications for high bandwidth Internet services. Chuck House, industry veteran from Hewlett Packard and Intel, came to Stanford as Executive Director of mediaX, establishing an informal board, the mediaX Distinguished Visiting Scholars, as an advisory group. He also established the Summer Institute at Wallenberg Hall at Stanford, which provided annual workshops on mediaX research themes for the wider community. In 2007 Dr. Russell joined these initiatives as she became Associate Director of mediaX.

mediaX weathers the recession of 2008 and expands globally

The economic turndown of 2008 was felt especially hard in Silicon Valley, and resources for the academic pursuit of human science and information technology research diminished, driving research resources into companies' internal research and development programs that sought to retain and grow their media businesses and become more productive. Both Reeves and Pea expanded their research agendas with large interdisciplinary and inter-institutional research programs funded by federal agencies. In 2011 Reeves stepped aside as Co-Director, and Pea became the sole Faculty Director of H-STAR and mediaX.

continued

Emergence and Evolution continued

In the wake of Stanford's decision to streamline the administration of institutes, the administrative home of mediaX was moved to Stanford's Graduate School of Education (GSE), the home of Pea's faculty appointment. Responding to the intensified need for human talent for innovative media, Mr. House accepted the position of Chancellor of Cogswell College in 2011, at which time Dr. Russell became Executive Director of mediaX, with a renewed focus on the human dimensions of information technologies to improve personal identity, agency, and productivity. During Dr. Russell's tenure, mediaX membership expanded to include a wide range of industry sectors and experience, with a global footprint extending from the US to European countries, Brazil, New Zealand, China, Taiwan and Morocco. Focal topics expanded to include Wellness. Participants in academia and industry shared an appetite to expand their thinking about the future and appreciated the sustainable advantage of collaborative discovery and innovation.

Throughout its work with Stanford researchers and corporate members, mediaX consistently created an environment designed to stimulate multidisciplinary inquiry on problems of interest to industry through strategic engagements between Stanford researchers and corporate members, typically investigating how the relationship between people, media and technology could be enhanced, augmented and improved. Applications of Stanford research insights contributed to the increased effectiveness of digital technologies used by consumers and improved the productivity of people using digital technologies in the workplace.

Additional programs for campus and industry interaction complemented the research agendas

- Regular conferences for the broader community
- Workshops for professionals and executives
- Themed conversations tailored for each member
- Personalized assistance for members wanting to establish specific research or consulting engagements with Stanford faculty members
- Seminar series to explore key questions, feature thought leaders and provide networking opportunities
- Video playback of event recordings, made available to the broader community. See: youtube.com/mediaxstanford
- The Global Innovation Leadership Workshop, to address leadership skills needed by mediaX industry liaisons wanting to use insights gained at Stanford to motivate change related to creativity, long-term thinking, ethics, and sustainability

mediaX innovates using long-distance collaborative technologies

As the COVID-19 pandemic forced "shelter-in-place" at Stanford and around the world, mediaX developed a virtual reality environment, mediaXploration, to host many of its large group activities. Seminars and conference events were adapted for online delivery, including the use of Zoom — an innovation that was first presented to mediaX in 2007 at a mediaX conference on the future of remote video communication. Each event included experimentation with new formats for presentation and discussion, including the introduction and use of several 3D virtual worlds.

mediaX poses a legacy of "Questions for the Future"

Supported entirely by member contributions, mediaX research inquiries focused on learning, gamification, remote communications, user-centered design, human-computer interaction, digital instruction, and — more recently — new terminologies to build a common vocabulary to describe human experiences in the digital world. Many Stanford labs and several university-wide programs have embraced the important questions raised by the community of mediaX members, including digital identity, personalization, potential and real reciprocity, and ethics for a human-centered mindset toward digital information technologies and socio-technical systems.

Questions surfaced in mediaX research initiatives, conferences and seminars brought together research interests and insights for pragmatic opportunities. The objective of these interactions was to inspire new ways of thinking and develop insights for shared vision. While mediaX programs have already initiated inquiries on some of these questions and organizations around the world are tackling one or more of them, the challenges are still considered open.

Questions for the Future, Appendix 6, have been curated from fall 2021 interviews with over 50 mediaX faculty and industry affiliates. They have been enriched with results of mediaX research and programs over the past 21 years. Addressing these opportunities will significantly impact our future world.

APPENDIX 2
mediaX at a Glance

Roy Pea, Martha Russell, Jason Wilmot, Addy Dawes and Elizabeth Wilsey.

APPENDIX 3

The Stanford mediaX H-STAR Ecosystem

Good questions are contagious.

When mediaX was established in 2001, its programs raised awareness of the need for inquiry and discovery at the intersections of human sciences and information technologies, the H-STAR theme — "media" broadly defined.

Thirty-one Stanford programs now address one or more of the issues mediaX identified at this intellectual intersection. Stanford programs with interests in H-STAR intersections active at the time of this publication (April 2022) are listed below. Some have affiliate programs and include industry colleagues in their discovery processes; those are indicated with "*".

AAALab

Led by Daniel Schwartz, the Awesomely Adaptive and Advanced Learning and Behavior Lab has a focus on cognitive science methods and extensive classroom experience. This lab explores how spatial cognition can inform and influence processes of learning, instruction, assessment and problem-solving. With research insights, they create pedagogy, technology and assessments to help students continue learning and adapting.

Behavior Design Lab

Led by BJ Fogg, the Behavior Design Lab is an interdisciplinary team of Stanford students, recent graduates and quantitative researchers. Using insights on human behavior, it works to create solutions for behavior change that effectively increase health, boost happiness and promote human flourishing.

CCRMA

Led by Chris Chafe, the Center for Computer Research in Music and Acoustics is a multi-disciplinary facility where composers and researchers work together using computer-based technology both as an artistic medium and as a research tool.

CESTA

Led by Giovanna Ceseani, the Center for Spatial and Textual Analysis is a digital humanities center that supports and encourages cutting-edge work across the humanities and the interpretative social sciences to investigate pressing questions about human history, experience and endeavor.

***CDR**

Led by Larry Leifer, the Center for Design Research develops concepts and technical solutions for design thinking, concurrent engineering, distributed collaborative design, design knowledge capture, indexing and reuse — focusing on methods and tools for improving the design of specific engineering systems.

Change Labs

Led by Banny Banerjee, this lab is structured to build capacity and connect people around systems transformation and leadership for interconnected, environmental, economic and social challenges.

***CodeX**

Led by Michael Genesereth, Computer Science, and Roland Vogl, Law, this program emphasizes the research and development of computational law (complaw) — the branch of legal informatics concerned with the mechanization of legal reasoning.

***Digital Economy Lab**

Led by Erik Brynjolfsson, this lab is an interdisciplinary research group studying how digital technologies are transforming work, organizations and the economy — towards a world of shared prosperity.

***Digital Cities**

Led collaboratively by Ram Rajagopal, Global Projects Center, and Mike Steep, the Disruptive Technologies and Digital Cities Program is a focused research effort bringing together cross-disciplinary expertise to explore how emerging technologies change the way we think about business model development for government and enterprises.

***EdTech**

Part of the Transforming Learning Accelerator, led by Daniel Schwartz, this program focuses on exploring unique opportunities to co-create interdisciplinary research projects, collaborate with Stanford teams, and connect with extensive networks of stakeholders, users, educators and policy makers.

Education Data Science

This Masters program integrates the complex and rich disciplines of computer science and statistics with education and social science theory to apply data science skills and techniques to education research and practices.

***eWEAR**

Led by Zhenan Bao, the Stanford Wearable Electronics (eWEAR) Initiative's Affiliate Program is a university-wide multi-disciplinary program conducting research on wearable solutions using sensors and wireless communications to allow remote collection of information and seamless human interfaces.

***HAI**

The Human-Centered Artificial Intelligence Affiliate Program provides opportunities for companies to interact with Stanford faculty and students, as well as other corporate members. Interaction is focused on responsibly guiding the future of artificial intelligence, with research focus areas of Human Impact, Augmenting Human Capabilities and Fundamental Intelligence.

continued

The Stanford mediaX H-STAR Ecosystem continued

HCI

The Human-Computer Interaction Group in the Computer Science Department offers weekly seminars and promotes research on human computer interaction.

***Longevity**

Led by Laura Carstensen, the Center on Longevity seeks to redesign long life by studying the nature and development of the human life span and exploring innovative ways to use science and technology to solve the problems of people over 50.

***LST**

Led by Mark Lemley and Roland Vogl, the Law, Science and Technology Affiliates Program addresses the many questions arising from the increasingly prominent role that science and technology play in both national and global arenas.

LSTD & LDT

The Learning Sciences and Technology Design PhD program is one of the leading global programs offering studies dedicated to the systematic study and design of psychological, social, and technological processes that support learning in diverse contexts and across the lifespan. LSTD students complete foundational research on learning, and they design innovative learning technologies. The Learning Design and Technology program offers a Master of Science degree and features a blend of theory and project-based courses, a real-world internship and a major design project.

***OVAL**

Led by Monica Lam, the Open Virtual Assistant Lab seeks to create an ecosystem for an open virtual assistant infrastructure.

PBL Lab

Led by Renate Fruchter, the Project-Based Learning Lab develops, implements, tests, deploys, and assesses radically new and innovative technologies that support collaborative, cross-disciplinary, geographically distributed teamwork and learning.

***SAIL**

Led by Chris Manning, the Stanford Artificial Intelligence Lab focuses on business and consumer tools such as speech recognition, semantic search, recommendation systems, machine translation and 3D sensing in consumer gaming.

Science Technology & Society

Directed by Paul Edwards, the interdepartmental STS Program offers both BA and BS degrees to students who want to gain an understanding of how science, technology and society interact.

Screenomics Lab

Led by Nilam Ram, Byron Reeves and Thomas Robinson, the Screenomics Lab is undertaking the human screenome project, which seeks to develop a technology platform, analysis process and data repository that more deeply understands humans' digital lives through the screenome.

Social Media Lab

Led by Jeffrey Hancock, the Social Media Lab works on understanding psychological and interpersonal processes that are affected by technology, especially in social media.

Symbolic Systems

Directed by Mike Frank, the Stanford Symbolic Systems program offers BS and MS degrees to prepare students with the vocabulary, theoretical background and technical skills to understand and participate in contemporary interdisciplinary research into questions about language, information, and intelligence — both human and machine.

VHIL

Led by Jeremy Bailenson, the Virtual Human Interaction Lab seeks to better understand the psychological and behavioral effects of Virtual Reality (VR) and Augmented Reality (AR).

Wearables Health Lab

Led by Matthew Smuck, this program takes an interdisciplinary approach to study human movement and wearable biosensor data to prevent orthopedic and neurological disease.

WTO

Led by Pamela Hinds, Robert Sutton and Melissa Valentine, the Center for Work, Technology and Organization investigates the nature of work in technical settings and explores organizational design issues at the intersection of work and technology.

Good questions are portable.

Stanford researchers supported by mediaX "seed grants" now hold faculty positions at leading universities. This diaspora includes but is not limited to:

Diane Bailey	Cornell University
Paulo Blikstein	Columbia University
Jeffrey Heer	University of Washington
Wendy Ju	Cornell University
Malte Jung	Cornell University
Scott Klemmer	University of California at San Diego
Lawrence Lessig	Harvard University
Nik Martelaro	Carnegie Mellon University
John Perry	University of California at Riverside
Ingmar Riedel-Kruse	University of Arizona
Jeffrey Schnapp	Harvard University
Andrea Stevenson Won	Cornell University
Barbara Tversky	Columbia University

APPENDIX 4

mediaX Members, 2001-2022

mediaX at Stanford University was a member-supported program. With their membership fees, the following organizations provided funds to create and sustain the mediaX program. Special acknowledgement and appreciation is given to 5-year and 20-year members of mediaX for the strong and deep relationships their continued memberships permitted.

20 years - OMRON

5+ years - AISIN, Fujitsu, HKUST, Konica Minolta, ITRI, Qitian, SEST SENAT

Over the twenty-one years of mediaX, 119 organizations have been members. (Memberships in the 2021-2022 year are in **bold** font)

AARP
Acario Innovation
Accel
Ai Tai Ji
AISIN
AisinTCA
Amada Corporation
Amanco
Apollo Group
Baidu
Best Buy
BigBonsai
BitTubes
Bluescape
Boeing
Breakroom / Sine Wave Entertainment
BT Group
Business Finland
Charles Schwab & Co., Ltd.
Chinese University of Hong Kong (CUHK)
Cigna
CISCO
CNT - Brazilian National Confederation of Transport
Conduent (Xerox Learning)
Cox Communication
Deutsche Telecom
DNP
Edelman
Eisai Innovation
Facebook/Meta
Forterra
France Telecom
Fuji Xerox
Fujitsu / Fujitsu Research of America
Futurewei
Futton, Inc.
FX Palo Alto Laboratory
Genentech
GlaxoSmithKline
Global Business Network
Good.co
Guangzhou Qitian Technology Co., Ltd.
Hewlett Packard / HP Labs
HKPC Training
Hong Kong Financial Services Institute (HKFSI)
Hong Kong University of Science & Technology (HKUST)
IBM
Icebreaker Ventures
Iizuka City
IMARK

continued

mediaX Members, 2001-2022 continued

Industrial Technology Research Institute (ITRI)
Institute for Business Education (IBE)
Intel
Intuit
IVOW
Japan Science & Technology Agency (JST)
Japan Innovation Network
Konica Minolta
Learning.com
Lycee d'Excellence
Macromedia
Mattel, Inc.
MediaMobz
Microsoft
Midea
Mohammed VI Polytechnic University (UM6P)
Mosaic
NASPERS
National Association of Convenience Stores
NCAST Corporation
News Corp
NHK
Nissan
Nokia
NTT Communication Science Lab
OCAHT
OMRON
Panasonic
Pearson
Philips
Prefixa
Prudential
Quindi Corporation
Qwaq
Reuters
Sabia Experience
Samsung
SAP
Savantas Policy Institute
Sense Observation Systems
Sesame Workshop
Sescon-SP
SESI-CNI
SEST SENAT
Skolkovo
Sprockit
Squirrel.Ai Learning
SRI International
State Farm Insurance
STATOIL
Steelcase Inc.
Sun Microsystems
Tampere University of Technology
Telecom Italia (TIM)
The Warehouse Group
THNK School of Creative Leadership
Time Warner
Tokyo Gas Company
Monte Toole Family Foundation
Toyota
University of Hong Kong (UHK)
US Bank
Venables, Bell & Partners (VBP Orange)
Vobile
Wisdom Academy
Xerox Learning
Xerox Business Services
Yamatake Corporation
Yindu Ogilvy

APPENDIX 5
mediaX Membership Levels and Benefits

Membership in mediaX at Stanford University was annual and could begin at any time. It required an invitation to Membership and a paid Membership invoice. It included participation in all mediaX-sponsored special interest programs and events. The first step upon joining as a Member was to identify a Liaison from the Member organization as a primary contact for communication and engagements with Stanford through mediaX.

Associate Membership

- Attendance at mediaX conferences, symposia, and formal presentations by faculty and students on new and ongoing research. This provided an opportunity for an informal exchange of ideas among industry representatives and mediaX affiliated researchers
- Eligibility to engage to identify Themed Topics for mediaX events, seminars, conferences
- Eligibility to send one or more Visiting Scholar(s) to Stanford for in-depth experiences with Stanford labs
- One day Themed Conversations, planned expressly for the member organization (see Themed Conversations, in adjacent column)

Karina Alexanyan and Addy Dawes welcome members to the 2015 mediaX Conference on Writing the Code for Personal Relevance.

Institutional Membership

- All the benefits of Associate Membership plus:
- Additional days of Themed Conversations at Stanford, topical meetings planned expressly for the Member organization (see Themed Conversations description below), or a dedicated Workshop with four half-day programs featuring Stanford thought leaders

Strategic Membership

- All the benefits of Associate Membership plus:
- Eligibility to engage Stanford thought leaders and their labs through a mediaX Research Theme and other themed discovery activities

Themed Conversations

Themed Conversations were day-long, customized programming developed in conjunction with a Member company. Thought leaders from Stanford, with expertise related to a selected theme or topic, presented their latest research. Themed Conversations usually ran from 9 AM to 5 PM. The agenda included an introduction, meetings with four to five Stanford researchers or professors, and a wrap-up discussion. A summary report of the ideas presented was prepared by mediaX for the member company. Depending on the scheduling needs of the Member Company, conversations could occur over multiple dates. During the Covid-19 Pandemic, Themed Conversations moved to a virtual format.

Dedicated Topical Workshop

A dedicated mediaX Workshop differed from a Themed Conversation in length, usually lasting several days. Thought leaders from Stanford, with expertise related to a selected theme or topic, presented their latest research to attendees from the member organization. Some workshops included grand challenges or project-based work, enabling practice application of the theoretical knowledge as it was learned. Workshops could be held at Stanford or at a Member location, usually running from 9 AM to 5 PM. The agenda was planned in conjunction with the member organization. Following the workshop, a summary report of the ideas presented/discussed was prepared. During the Covid-19 Pandemic, Topical Workshops were moved to a virtual format.

continued

mediaX Membership Levels and Benefits continued

mediaX Research Theme

The mediaX Research Theme program was distinct from internal or corporate R&D initiatives. By inviting concept-proving discovery on edge questions that addressed complex issues, a mediaX Research Theme tapped the intellect of Stanford research leaders to explore research questions that had not been articulated before. A Research Theme was formed in response to Strategic Members' questions, usually framed on a three to five-year horizon. Stanford labs proposed new ways to explore the question. Following review and expressions of interest by Strategic Members, mediaX issued Requests for Proposals (RFPs) from the Stanford research community, and a small faculty committee appraised and selected the Projects to be awarded.

A launch meeting was scheduled with the winning Project teams, and after an appropriate time frame, Stanford researchers shared updates on their results. mediaX provided a summary to the Strategic Members at the conclusion of the Project funding period. The goal of the research that mediaX funded was creation of new knowledge as well as expanding the network of Members and academics. When research resulted in the creation of intellectual property, mediaX followed disclosures protocols of Stanford's Office of Technology Licensing (OTL). OTL worked with companies for licensing and other agreements.

mediaX Visiting Scholars

The Visiting Scholar program was intended to build relationships for discovery through mutually beneficial intellectual exchanges. Each Visiting Scholar came as an invitee of a Stanford faculty member who acted as the official host and mentor on campus. All visiting scholars had to meet the eligibility criteria for Stanford visitors and were required to follow Stanford University policies.

A Visiting Scholar is a recognized position at Stanford, with benefits of a Visiting Scholar ID card. This card allows a visitor to enjoy the privileges of regular Stanford faculty, including:

- Full library access
- Access to SUNet (the Stanford University Data Network)
- Eligibility to attend a Stanford course or participate in a seminar, subject to instructor's permission
- Eligibility for faculty discounts at the Stanford Bookstore
- Access to Stanford University's athletic facilities
- Staff-rate tickets to athletic events
- Eligibility to purchase campus parking permits
- Access to off-campus housing information

Visiting scholars were expected to bring their own laptop or desktop computer. Visiting Scholars who were residents at Stanford for a period of more than one academic quarter (three months) were subject to Stanford's Intellectual Property Policies. All Visiting Scholars were required to sign the intellectual property agreement form SU-18A and abide by its conditions.

Kyu Sub Kwak, Young Yoon Lee, Martha Russell and Tammy Lee at reunion of Samsung Visiting Scholars in Seoul, South Korea (Jaeyoun Cho not shown).

APPENDIX 6
Questions for the Future

The following Questions for the Future have been contributed by mediaX faculty and industry affiliates. They have been enriched with results of mediaX research and programs over the past 21 years. While mediaX programs have already initiated inquiries on some of these questions and organizations around the world are tackling one or more of them, the challenges are still considered open. Concerted collaboration is needed to develop insights and implement solutions. These questions, and other questions that derive from them, are intended as resources to be shared widely, as the next generation of opportunities for our future come into view.

1. **Curiosity to Drive Purpose –** How might socio-technical systems be leveraged to cultivate a sense of curiosity, agency and creativity, facilitate lifelong learning, and create pathways for future personal growth opportunities?
    a. How can the thoughtful design of learning tools develop opportunities that support and enhance uniquely human capabilities, cultivate a sense of innovation and creativity, activate potential, and maximize learners' competence to adapt — for all ages, including older generations?
    b. How can socio-technical systems be designed to support teacher wellbeing while fostering innovative curricula and teaching methods?
    c. How can human factors and context dependency be integrated into the assessment of learning, widening the lens of assessment culture to focus on assets of learners and rejecting deficit framing?
2. **Insights for Dignity and Wellbeing –** How might socio-technical systems anticipate and build a moral commitment to the human ethical values of diversity, equity, inclusion and justice for mutually beneficial implementation — for both individual and collective wellbeing?
    a. What new knowledge is needed to thoughtfully define and measure the emotional impact of machine augmentation of humans — considering both intentions and consequences, as well as an awareness of the phenomena that cannot be captured by technologies?
    b. How can new tools and systems, such as wellness monitoring devices, help people to understand more intimately how their bodies and minds work and how they interact with the physical and social world?
    c. How can socio-technical systems be designed to equitably facilitate participatory governance, personal agency and dignity for all people?
3. **Humanized Workflows –** How might human science insights guide the development and deployment of technologies to enable work to be done more pleasantly and ultimately with more human-to-human connection and wellness?
    a. How can socio-technical systems be designed to enable workers to build on previous knowledge while adapting to changes in environment, information and new challenges and while incorporating young talent into the labor pool?
    b. How can human/machine interactions for skills, training and support systems in the workplace support competence and confidence in trusting relationships?
    c. What information is needed to develop new tools and systems which will respectfully enhance presence in the mechanized representation of humans (embodiment), to foster connection as well as productivity?
4. **Communication Across Boundaries –** How might researchers inform the co-evolution of technology-media-human relationships in ways that assist people in building bridges and facilitating communication between generations and across boundaries of expertise and experiences?
    a. How can socio-technical systems sustain personal agency and inform policies that promote access to opportunity for young generations?
    b. How can socio-technical systems be designed to support interpersonal relationships and community development?
    c. How can technology design and deployment foster empathy and cross-cultural communication?
5. **Stories for Sustainability and Growth –** In what ways can media, media platforms and storytelling be leveraged to develop new understandings of the physical world and how humans interact with it, to inform and motivate actions towards a more sustainable future?
    a. How might technology inform the interrelated dynamics of sustainability to help individuals and organizations make choices and take actions to improve collective and planetary health and beyond?
    b. How can technologists and storytellers work together to share visions of positive socio-technical futures?
    c. How might industry and universities collaborate on reviving and sharing the success stories of under-represented innovators to support and inspire future leaders?

continued

Questions for the Future continued

6. **Trust Enhancing Technologies –** How might developments in information technologies facilitate interpersonal dynamics and interactions to foster and renew trusting and mutually beneficial relationships between people, between people and systems, and among systems?

   a. How can technology be designed and deployed to empower individuals to build robust, multidimensional human-to-human connections?

   b. How can socio-technical systems help create collaborative and durable communities of trust?

   c. How can rich media experiences be validated as authentic, to foster trust, empathy and deeper interpersonal bonds?

7. **Protected and Secure Identity –** How might the emerging tech of ubiquitous computing, context awareness and embodiment be channeled to improve lives while protecting privacy and personal identity?

   a. What new knowledge is needed to leverage ubiquitous computing for addressing the diversity of needs in the world?

   b. Given the necessity of information exchange, how can a secure and respectful information relationship be described and appraised — across varying contexts and objectives?

   c. How can we develop sociotechnical systems that foster resilience to disinformation?

8. **Empowerment Through Institutions –** How might corporations, universities and organizations develop structures, technologies, and decision pathways to productively empower people to make progress towards resolving the societal challenges of today and tomorrow?

   a. How can the values of human-centered perspectives be integrated into business plans and priorities beyond single and self-contained goals?

   b. How can the consequences of trade-offs in value-based assumptions of sociotechnical systems be clarified and balanced with broader aims?

   c. How can shifts in mindsets for collective good and the awareness that human values are embedded in the design and deployment of sociotechnical systems be cultivated across generations and cultures?

9. **Meaningful University-Industry Collaboration –** How might university-industry collaborations provide leadership for intellectual risk-taking, research design, and knowledge creation?

   a. How can practices and insights from creativity and design be incorporated into research, knowledge creation and technology development?

   b. How can the serendipity that creates inspiration for innovation be energized and sustained?

   c. How can industry-academic collaborations encourage intellectual risk-taking and wild-card ideas to explore and discover insights to conquer the grand challenges?

10. **What questions are driving your future?**

There's more we can do together than any of us can do alone.

Join the conversation online!

APPENDIX 7
mediaX Research Themes and Projects

Twenty-one mediaX Research Themes were activated through conversations between mediaX academic and corporate colleagues. The Research Themes and awarded Projects are condensed here into eighteen ThemesFor many Projects, additional information is available on the mediaX website. Project awards were made to 121 research teams, including researchers from 31 Departments and all 7 Stanford colleges.

2001 Social and Computing Sciences

What insights about people and technology are needed to better understand the cognitive, behavioral and visual aspects of information processing?

To help answer this question, mediaX sponsored five research projects that leveraged social science perspectives for a deeper understanding of human interactions with computers, mobile devices and other digital technologies. Research initiatives highlighted projects that explored the intersection between language, information and cognitive science, including research into technologies for natural language processing, as well as visual information processing. Projects also examined persuasion for behavior change via mobile devices and the use of interactive technologies for learning by having students teach a computerized agent.

Research Initiatives

- ***Johan van Benthem:*** *Communication, Computers and Cognition*
- ***Abby King & B.J. Fogg:*** *Persuasion through Mobile Devices and Operant Conditioning via Interactive Technology*
- ***Christopher Manning:*** *Rich and Dynamic Treebank for Head-driven Phrase Structure Grammar (HPSG)*
- ***Dan Schwartz:*** *The Willful Pupil Project*
- ***Barbara Tversky:*** *Spatial Meaning Constraints in Visual Language Reading*

2002/2003 Sensing and Control

How can we better understand advances in the use of sensing and video technologies for education, health care and business?

To help answer this question, mediaX sponsored research projects that leveraged advances in sensing and video technologies for use in a variety of contexts. Research initiatives highlighted projects that explored the use of sensors in the development of innovative science education curricula, the use of sensors and video technology to increase the mobility and independence of those who are blind or visually impaired, and haptic sensors that could leverage natural physical interaction with a handheld device for graphic design. Additional projects leveraged advances in computer vision to explore opportunities for rapid digitization to track the 3D shape of a moving or changing object, and devices to capture, store and display a high dynamic range of image data for next generation digital cameras and display devices.

Research Initiatives

- ***Larry Leifer:*** *Blind Navigator*
- ***Larry Leifer and Mark Bolas:*** *Force Input Device for Graphical Environment Tweaking*
- ***Marc Levoy:*** *High Speed 3D Shape Digitization Using Projected Light Patterns*
- ***Roy Pea:*** *Marking SENS: Science Education Networks for Sensors*
- ***Brian Wandell:*** *High Dynamic Range Image Capture and Display*
- ***Abbas El Gamal:*** *Collaborative Visual Sensor Networks*
- ***Cliff Nass:*** *User/Agent/Avatar Modeling Framework for Multiple Contexts: Psychology and Design of Phase II Project*
- ***Mark Bolas:*** *Interactive and Networked Toys: Using Sensing Technologies to Create Social Awareness*

2003 Learning and Training

How can we better understand advances in the digital technologies for education, collaboration and well-being?

To help answer this question, mediaX sponsored four research projects that explored the use of emerging interactive technologies for learning, behavior change and collaboration. Research initiatives included a project that enabled language learners to practice conversation with an interactive system capable of feedback and evaluation, as well as a project leveraging the power of learning by teaching, by having students engage with an interactive teachable agent. Other projects explored the potential for behavior change with interactive narrative experiences delivered via mobile devices and examined the effect of audio latency and delay on networked musical collaboration.

Research Initiatives

- ***Chris Chafe:*** *What's the Delay? Audio Latency and Its Effect on Networked Musical Performance*
- ***BJ Fogg:*** *Persuasive Narratives Delivered via Mobile Devices: Investigating How Computer Supported Stories Can Change People*
- ***Daniel Schwartz:*** *A Teachable Agent for Strategy Learning in Management Training*
- ***Thomas Wasow:*** *Learning English via Robust Conversation*

continued

mediaX Research Themes and Projects continued

2003 Video Processing, Cataloging, Retrieval and Reuse

How can we better understand and develop automated systems to support video libraries?

To help answer this question, mediaX sponsored four research projects that explored interactive technologies related to video processing, cataloging, retrieval, and reuse. Research initiatives investigated ways to use computation to capture, investigate, search, segment and otherwise manipulate content and information across various media.

Research Initiatives

- ***Helmut Krawinkler & Renate Fruchter:*** *DIVAS: Digital-Video-Audio-Sketch, Re-use of Rich Contextual Gesture-Discourse-Sketch Knowledge*
- ***Christopher Manning:*** *Interactive Computational Assistants for Video Segmentation and Classification*
- ***Roy Pea:*** *Accelerating the Usefulness of Video Libraries through Hyperdiving*
- ***Stanley Peters:*** *Structuring Video Content with Assistance from the Sound Track*

2004 Social Interaction and Collaboration

How can we better understand and use interactive technology for social interaction and collaboration in productivity contexts?

To help answer this question, mediaX funded 11 research projects that explored technologies involving the synchronous and asynchronous uses of text, graphics, voice, and video for educational and professional contexts. Examples included web and video conferencing, whiteboarding, application sharing, email, IM, VOD, and speech recognition and synthesis. Research projects included examinations of collaboration in virtual environments, gaming, distributed work, cross cultural contexts, and learning.

Research Initiatives

- ***Jeremy Bailenson:*** *Social Interaction in Collaborative Virtual Environments*
- ***Julius Smith:*** *Context Sensitive Audio Analysis for Interactive Multimedia Indexing*
- ***Mark Cutkosky:*** *Tactor.Net: Multi-User Gaming and Training with Tactile Interaction*
- ***Helmut Krawinkler & Renate Fruchter:*** *TalkingPaper: Interactive Multi-user Multimedia Knowledge Capture, Sharing & Reuse*
- ***Pam Hinds:*** *Finding Knowledge: Understanding Impression Accuracy in Distributed Work*
- ***Raymond Levitt:*** *Integrated Concurrent Engineering Technologies and the Media X Project*
- ***Larry Leifer:*** *PBL-X: Exploring Social Software Applications to Support Next Generation Product-Based-Learning with Corporate Partners and Learning Portfolios*
- ***Cliff Nass:*** *Cross Cultural Characters and Avatars: eLearning Analysis*
- ***Roy Pea:*** *Group Diving: Distributed Collaborative Work on Video Documents*
- ***Dan Schwartz:*** *The Benevolent Demon: A Hidden Conductor for Orchestrating Learning Interactions*
- ***Terry Winograd:*** *Collaborative Design for Capturing and Communicating Project Results*

2004 Mobile Devices in Collaboration

What insights about people and technology are needed to better understand mobile device form factors, applications and connectivity?

As alternative form factors beyond the desktop and laptop continue to advance, the options for access to information increase. This raises key issues of application, security, connectivity and human psychology. mediaX funded eight projects to explore the implications for supporting networks of daily activities (work and otherwise) on mobile devices.

Research Initiatives

- ***Helmut Krawinkler & Renate Fruchter:*** *A2D Bridging the Analog to Digital Multimedia Worlds in Support of Collaboration Among Mobile Knowledge Workers*
- ***Roy Pea:*** *User Interface Principles for Mobile Video Diving*
- ***Kenneth Salisbury:*** *Hand-Shake: Expressive Haptics for Collaboration Mobile Devices*
- ***Ramesh Johari:*** *Harnessing Positive Externalities in Network Services*
- ***Terry Winograd:*** *Eye Tracking as an Augmented Input*
- ***Scott Klemmer:*** *Helping Mobile Devices Share with Walls That Remember*
- ***Shelley Goldman:*** *Mobile E-Learning Initiative in South Africa (ELISA): Porting Distance Learning Programs Across Cultures and Contexts with Mobile Technologies*
- ***Cliff Nass:*** *Receiver-Centered Model for Mobile Phones: A Series of User Studies and Experiments*

2004 Emotion Detection Facial Expressions

How can we better detect and understand emotions from facial expressions captured in video — especially for use in driver monitoring for automotive safety.

To help answer this question, mediaX funded two research projects that investigated emotion detection from real time video capture of facial expressions. The goal was to enable the automatic detection of a driver or passenger's alertness, fatigue and other emotional states through the use of video and facial recognition technologies.

Research Initiatives

- ***Jeremy Bailenson:*** *Emotion Detection from Real Time Video Capture of Facial Expressions During Driving: Technology, Assessment, and Use*
- ***Robert Dougherty:*** *A Robust Calibration-Free Gaze Tracking System*

2005 Online Media Content

What insights about people and technology are needed to better understand the technological, social and legal ramifications of the growing ability to personalize online content?

With the trend for online content providers to allow users to tailor content to meet their own preferences, there was a growing need for research into the ways that users and producers interacted with content, including the economics of information and information personalization. This mediaX research challenge focused on two key research areas – ontologies and "consumers as publishers". Ontologies addressed ways that users and providers structure, categorize, value and customize content. "Consumers as publishers" addressed the technological, procedural, and/or legal mechanisms that facilitate consumer publication, including issues of Internet law and personalization technologies. Projects explored, for example, the parameters of a legal environment for online publication that protects creators of digital content while promoting free expression. Researchers also considered issues of reputation, trust and anonymity online, including rating and ranking systems. Scholars experimented with collaboration, tagging, bookmarking and personalization of online educational and consumer video content. They also explored the social and psychological aspects of user interaction with integrated information, including perceptions of quality, origin and reliability.

Research Initiatives

- ***Ashish Goel:*** *Trust, Reputation, and Anonymity in Peer to Peer Publishing and Content*
- ***Cliff Nass:*** *Interacting with Integrated Information*
- ***Roy Pea:*** *DIVER ROMP: Research on Online Media Personalization*
- ***Margaret Jane Radin:*** *Law, Science and Technology Proposal*
- ***Terry Winograd:*** *Online Media Bookmark Manager*

2006 Human-Machine Interaction and Sensing

What insights about people and technology are needed to better understand the use of sensors in human machine interaction?

To help answer this question, mediaX sponsored six research projects exploring new insights into Human-Machine Interaction with a focus on the detection or sensing of human comprehension, emotional states, gesture or touch. The projects were launched in the Spring of 2006 and spanned a wide range of topics, including: affective computing, smart home technologies, design, communication and collaboration, teaching and learning, training, physical therapy and injury prevention, and Augmented Reality (AR). The research initiative enabled projects exploring technologies for emotion detection, real time video capture, gesture recognition, vision-based reasoning, machine learning, biofeedback and Augmented Reality.

Research Initiatives

- ***Jeremy Bailenson:*** *Detection of Comprehension and Emotion from Real-time Video Capture of Facial Expressions During Learning*
- ***Andrea Goldsmith:*** *Smart Home Care Network Using Distributed Vision-Based Reasoning*
- ***Scott Klemmer:*** *Designing Sensor Based Interactions by Example*
- ***Amy Ladd & Jessica Rose:*** *Human Machine Interaction and Sensing of the Golf Swing*
- ***Cliff Nass:*** *Revealing and Using Emotion Detection*
- ***Andrew Ng:*** *Gestures, Speech and Vision–Towards a Multi-Modal Augmented Reality Human-Robot Interface*

2007 Virtual and Physical Realities

What insights about people and technology are needed to better understand the rise of the digital and virtual, and its intersection with real and physical worlds?

To help answer this question, mediaX sponsored eight research projects exploring new insights at the intersection of virtual and physical worlds. The projects spanned a wide range of topics, including: education and learning architecture, sensor networks, the psychology of presence and place, mixed media and mixed reality for cultural curation and legal regimes. Research projects examined the interaction of physical objects and their virtual counterparts, especially the potential and implications of synchronizing or harmonizing virtual worlds with physical ones. They also explored psychological effects, developing novel learning architectures and experimenting with sensors and other measuring and tracking devices. These projects addressed the broad influence of computer technology on human communication, with an emphasis on the intersection of objects in real space with virtual world information, and the potential to leverage computer- and/or sensor-embedded objects and context-aware computing for the development of new design, prototyping and communication systems.

Research Initiatives

- ***Jeremy Bailenson:*** *Real Time Tracking, Detecting and Correcting of Motion*
- ***Diane Bailey:*** *Exploring the Virtual in the Physical and the Physical in the Virtual*
- ***Pat Hanrahan:*** *Virtual Sensor Networks*
- ***Kincho Law:*** *ShowMeTellMe: Multimodal Learning Experience Mediated by the Future Interactive Paper TextBook*
- ***Lawrence Lessig:*** *Virtual Jurisdictions*
- ***Jeffrey T. Schnapp:*** *SPEEDLimits*
- ***John Perry:*** *Pragmatics of Computer Assisted Communication and Communication about Virtual Worlds*
- ***Byron Reeves & Anthony Wagner:*** *Learning in the Digital World: The Impact of Social Belief on the Neurophysiology of Memory*

continued

mediaX Research Themes and Projects continued

2011 Productivity of Knowledge Workers

What insights about people and technology are needed to develop metrics that can be used to measurably increase the productivity of knowledge workers?

As technology evolves, workplace systems and practices also evolve, shaping how people engage, work, and communicate with others. Understanding knowledge worker productivity can have significant impact on technologies developed for and implemented in the workplace. This Research Theme was launched in response to the intense global competition fueled by exponential technology growth that was reshaping industries across sectors, changes in working spaces, and new expectations of workers. Ten concept-proving projects received mediaX seed funding.

Research Initiatives

- ***Jeremy Bailenson:*** *Detecting States of Mind Through Non-verbal Behavior Using the Microsoft Kinect*
- ***Rhiju Das:*** *EteRNA: Accelerating Knowledge Creation for RNA Bioengineering through Internet-Scale Gaming*
- ***Carol Dweck:*** *Supporting Self Regulation for Online Course Students*
- ***Martin Fischer:*** *Leveraging Team Information Interactions to Reveal Project Workflows*
- ***Pamela Hinds:*** *Creativity and Culture: Understanding Team Creativity and What Fosters It*
- ***Kincho Law & Renate Fruchter:*** *A Journey from Islands of Knowledge to Mutual Understanding in Global Business Meetings*
- ***Larry Leifer:*** *Interaction Using Situated Spatial Gestures*
- ***Cliff Nass:*** *Designing Technologies that Mediate Human Social Interaction: Strategies for Effective Cooperation and Collaboration*
- ***Roy Pea with Neema Moraveji, Jeff Heer:*** *The Utility of Calming Technologies in Integrative Productivity*
- ***Allan Reiss:*** *Finding Behavioral and Neural Signatures for Collective Creativity in Groups*

2012 Future of Content

What new insights can inform the way individuals and organizations will consume media and the way such content will be curated for learning?

As location-aware functions on mobile devices grow in capacity, new services that enable learning, provide personalization, and assure integrity — trust, security and authenticity — are being developed for individuals and organizations. These types of changes impact media content in learning environments of all types — higher education, K-12, continued education, and workplace education. They also impact the way individuals and organizations create and consume media content for learning purposes, and they expand the meaning and opportunities for curation as well. mediaX sponsored seven experimental activities to test and verify new forms and uses of content for learning and collaboration.

Research Initiatives

- ***Brigid Barron:*** *Contests as a Catalyst for Content Creation: Contrasting Cases to Advance Theory and Practice*
- ***Ingmar Riedel-Kruse & Paulo Blikstein:*** *A New Generation of Hybrid Tangible Interfaces for Learning*
- ***Cliff Nass:*** *Physical Media as Active Social Learning Agents*
- ***Sakti Srivastava:*** *The Stanford Clinical Anatomy (SCAnS) Library*
- ***Paulo Blikstein:*** *The Contextual Future of Situated Schools*
- ***Kincho Law & Renate Fruchter:*** *The Interaction Archetypes in Global Teamwork*
- ***Larry Leifer:*** *Enabling Impromptu Interaction Through a Robotic Water Cooler*

2012 Publish on Demand

What insights about people and technology are needed to ride the sea change of publish-on-demand into the future?

The world of media has been experiencing a big wave of innovation. The way content is created, consumed and curated has changed dramatically over the course of the last few years. In publishing, this innovation has erupted in what some call the "mass amateurization" of media and extends to how traditional content creators and distributors are restructuring new business models and personalizing content. New data flows and data management models in self- publishing and open publishing are changing the way businesses think about educational, research, trade and leisure content. mediaX funded seven projects to explore "signals of change."

Research Initiatives

- ***Jeffrey Heer:*** *Transparent Social Footprints*
- ***Ramesh Johari:*** *Content on the GO; the Economics of the Market for Mobile Apps*
- ***Scott Klemmer:*** *TweakCorps: Retargeting Existing Webpages for Diverse Devices and Users*
- ***Robert Laughlin:*** *Decision Products and Their Long Term Integrity*
- ***John Willinsky:*** *Smarter Scholarly Texts*
- ***Sam Wineburg:*** *Recasting the Textbook*
- ***Michael Genesereth:*** *Publish on Demand for Legal Course Readers*

2015 Insights from Digital Learning

How can we better understand innovations in digital and blended learning technologies, and their implications for teaching, learning practices and pedagogy?

To help answer this question, mediaX sponsored seven research projects that explored emerging digital technologies for learning and teaching. Some projects explored how innovations such as Virtual Reality experiences and math video games can enhance learning. Other projects investigated the influence of digital tools on online educational interactions. These included a real-time social communications tool, as well as a social annotation platform. Projects also examined psychological aspects of digital learning — including how student and teacher attitudes towards mental efforts and challenges affect learning outcomes and how racial representations in a digital textbook can impact a student's sense of belonging and involvement and their performance. An additional study explored the labor market effects of digital learning, with a focus on the influence of Massive Online Open Courses (MOOC) credentials on the perceived employability of job applicants.

Research Initiatives

- ***Paulo Blikstein:*** *Real-Time Social Communications Environments for Online Class Engagement and Peer to Peer Learning*
- ***Jo Boaler & Keith Devlin:*** *Developing Written and Game-based Assessment Tools to Measure the Effectiveness of Math Video Games*
- ***Bryan Brown:*** *Language, Race & Cognition Using Digital Text*
- ***Thomas Dee:*** *The Labor Market Effects of Digital Learning: Evidence from a Field Experiment*
- ***Carol Dweck:*** *Developing a Diagnostic of Mindset Promoting Practices*
- ***Amir Eshel & Candace Thille:*** *Lacuna Stories*
- ***Roy Pea, Fiorenza Micheli & Jeremy Bailenson:*** *Assessing Learning in a Virtual Reality Field Trip*

2015 Memory, Estates and Legacies

How might insights about people and information technologies inform the identification of the digital estate as a new metaphor for situating digital activities and recognizing the self in the digital medium?

Individuals engage with an ecosystem of digital technologies to create and use valuable digital assets that shape their lives and the society as a whole. The elements of a virtual legacy or personal digital estate are linked through the individual's identity and personae. Ecosystem elements include school, employer and community portals and comprise both personal and institutional boundaries. Yet, at the moment, the ecosystem lacks user-centered organizing principles that would help people manage, reason about and assert control over digital interactions and digital possessions through a lifetime, and afterwards. mediaX funded four research projects to explore elements of a virtual legacy or personal digital estate.

Research Initiatives

- ***Wendy Ju:*** *Voyage of Discovery: Capturing and Considering Multimedia Journey Narratives*
- ***Nicholas Jenkins:*** *Kindred Britain*
- ***Byron Reeves:*** *The Digital Estate and Identity in the New Landscape of Work*
- ***Maneesh Agrawala:*** *Designing an Interactive, Browsable Archive of Video-based Digital Estates*

2017 Smart Office Work Flows

What insights about people and technology are needed to better understand workflow, communication and productivity in sensor-rich environments?

Personal, team and organizational work styles and workflows have changed as a result of information technology in sensor-rich computational environments. The ways that people relate to work, and through it to one another, add new dimensions to identity, wellness, reciprocity, trust, authenticity, memory, transparency, and service. This theme explored insights about productivity in the technology-enabled offices of the future. It focused on workflow, communication and production in knowledge work and learning environments that are augmented with sensing technologies, robotics and artificial intelligence.

Research Initiatives

- ***Michael Bernstein:*** *Dream Team: Computational Techniques for Adaptive Teams*
- ***Larry Leifer:*** *Real Time Knowledge Capture and Feedback in Design Workspaces*
- ***Larry Leifer:*** *Making Noise Intentional: Capturing and Designing Robotic Sonic Expression*
- ***Allison Okamura:*** *Haptic Tether for Human Robot Communication*

continued

mediaX Research Themes and Projects continued

2017 Potential, Performance, Productivity

What insights about people and technology are needed to better understand potential, performance and productivity in the workplace?

Technical advances in neuroscience, human and computer intelligence, machine learning, robotics and predictive algorithms are transforming many aspects of the employee experience. In this context, understanding the interface between people and information technologies takes on increased importance for educators, HR, employers and employees. This Research Theme supported research leading to insights about the potential, performance and productivity of knowledge workers. Five projects explored compelling opportunities that aimed to empower leadership, learning, professional development, performance, productivity and agile team construction and management.

Research Initiatives

- ***Michael Bernstein & Margaret Levi:*** *Vitae: Digital Hiring Halls for On Demand Workers*
- ***Geoffrey Cohen:*** *Harnessing the Psychological Power of Virtual Reality to Enhance Leadership in High Diversity Teams in STEM*
- ***Pamela Hinds:*** *Where are the Breakdowns? Surveying Unsuccessful and Failed Uses of Data*
- ***Ingmar Riedel-Kruse & Michael Bernstein:*** *Coordinating Expert Flash Teams on the Biological Internet of Things*
- ***Melissa Valentine & Stephen Barley:*** *New Training Models for the Digital Workforce: The Case of Coding Bootcamps*

2019 Ontologies of the Human Learning Experience

How can we leverage ontological models to better understand the human learning experience?

In this research theme, the Stanford community was challenged to inform ontological models that could provide a standardized system for representing human learning experiences. Such ontologies are expected to enable diverse academic and industry researchers to align on ground truths, measurements, and data interpretation from a variety of activities and experiences. Three research projects leveraged multi-disciplinary perspectives and used data from individual human behavior to inform critical aspects of the human learning experience: attention and engagement, thinking and choosing, personalization, practice and physical skills. They provided proofs of concept for new research methods and built trajectories of inquiry for future research. Importantly, these projects opened educational opportunities for the next generation of world-class researchers. The research also generated new questions, validated the need to refine tools and measurement capabilities, and ignited the researchers' desire to continue pursuits inspired by this work.

Research Initiatives

- ***Carla Pugh:*** *Creating an Ontology for Human Motion and Psychomotor Performance: A Look at Surgical Skill as a Use Case*
- ***Thomas Robinson, Nilam Ram & Byron Reeves:*** *Screenomics: A Venue for Developing an Ontology of Informal Learning through Everyday Digital Media*
- ***Daniel Schwartz:*** *An Ontology of Choice-Based Learning*

2020 Taxonomies for Differentiation and Personalization

(a collaboration with Stanford's Transforming Learning Accelerator)

How might we develop a shared language representing the uniqueness of human experiences, to enable personalized learning opportunities?

To address this complex question, mediaX supported five innovative projects that explored how to describe the human experiences involved in learning, social interaction, emotion-regulation, and motivation, with an emphasis on autistic and neurodiverse individuals. Understanding the opportunities generated by focusing on ability rather than disability, these projects offered inspiration for high impact interventions and new support opportunities for neurodiverse and disabled individuals, as well as enormous potential for long-lasting impact on learning sciences.

Research Initiatives

- ***Nick Haber:*** *Developing a Computationally Precise Description of Early Interactive Learning and Its Impact on Later Development*
- ***Bruce McCandliss:*** *Toward New Taxonomies of Students by Treatment Interactions in Special Education: Validating Neural Metrics of Engagement with Naturalistic Stimuli using Mobile EEG*
- ***Nilam Ram:*** *Dynamic Learning Maps & Boolean Network Methods to Study Self-Regulation Development*
- ***Dennis Wall:*** *Using AI Analysis of Mobile Games to both Track and Treat a Continuum of Early Childhood Learning*
- ***Jason Yeatman:*** *Automated Online Assessment of Reading Ability to Enable Personalized Education*

APPENDIX 8

mediaX Researchers and Visiting Scholars

mediaX-funded Stanford Principal Investigators and Researchers

Maneesh Agrawala, Computer Science
Russ Altman, Medicine
Arto Anttila, Linguistics
Jeremy Bailenson, Communication
Diana Bailey, Management Science & Engineering
Stephen Barley, Management Science & Engineering
Brigid Barron, Education
Michael Bernstein, Computer Science
Chip Blacker, Institute for International Studies
Paulo Blikstein, Education
Jo Boaler, Education
Mark Bolas, Mechanical Engineering
Lera Boroditsky, Psychology
Joan Bresnan, Linguistics
Bryan Brown, Education
Chris Chafe, CCRMA
Larry Chu, Medicine
Eve Clark, Linguistics
Herbert Clark, Psychology
Geoffrey Cohen, Education
Mark Cutkosky, Mechanical Engineering
Rhiju Das, Biochemistry
Thomas Dee, Education
Parvati Dev, Medicine
Persi Diaconis, Mathematics
Robert Dougherty, Psychology
Carol Dweck, Psychology
Penny Eckert, Linguistics
Abbas El Gamal, Electrical Engineering
Amir Eshel, Comparative Literature
John Etchemendy, Philosophy
Martin Fischer, Civil & Environmental Engineering
James Fishkin, Communication
BJ Fogg, Behavior Design Lab
Renate Fruchter, Civil & Environmental Engineering
Michael Genesereth, Computer Science
Ashish Goel, Management Science & Engineering
Shelley Goldman, Education
Andrea Goldsmith, Electrical Engineering
Leonidas Guibas, Computer Science
Nick Haber, Education
Stig Hagstrom, Materials Science & Technology
Kenji Hakuta, Education
Jay Hamilton, Communication
Pat Hanrahan, Computer Science
Jeffrey Heer, Computer Science
Craig Heller, Biology
Pamela Hinds, Management Science & Engineering
Shanto Iyengar, Communication
Nicholas Jenkins, English
Ramesh Johari, Management Science & Engineering
Dan Jurafsky, Linguistics
Martin Kay, Linguistics
Abby King, Medicine
Scott Klemmer, Computer Science
Vladlen Koltun, Computer Science
Helmut Krawinkler, Civil & Environmental Engineering
Amy Ladd, Medicine
Robert Laughlin, Physics
Kincho Law, Civil & Environmental Engineering
Larry Leifer, Mechanical Engineering
Lawrence Lessig, Law
Margaret Levi, Political Science
Philip Levis, Computer Science
Raymond Levitt, Civil & Environmental Engineering
Marc Levoy, Computer Science
Tanya Luhrmann, Anthropology
Chris Manning, Linguistics
Bruce McCandliss, Education
Fiorenza Micheli, Biology
Na'ilah Nasir, Education
Cliff Nass, Communication
Andrew Ng, Computer Science
Allison Okamura, Mechanical Engineering
Marc Pauly, Philosophy
Roy Pea, Education
Deanne Perez-Granados, Education
John Perry, Philosophy
Stanley Peters, Linguistics
Carla Pugh, Medicine
Margaret Jane Radin, Law
Nilam Ram, Communication
Byron Reeves, Communication
Allan Reiss, Psychiatry
John Rickford, Linguistics
Ingmar Riedel-Kruse, Bioengineering
Tom Robinson, Medicine
Ivan Sag, Linguistics
Manish Saggar, Psychiatry
Kenneth Salisbury, Computer Science
Jeffrey Schnapp, French & Italian
Dan Schwartz, Education
Sheri Sheppard, Mechanical Engineering
Julius Smith, CCRMA
Sakti Srivastava, Surgery
Pat Suppes, Philosophy
James Sweeney, Management Science & Engineering
Claire Tomlin, Aeronautics & Astronautics
Fred Turner, Communication
Barbara Tversky, Psychology
Guadalupe Valdes, Education
Johan Van Bentham, Philosophy
Roland Vogl, Law
Anthony Wagner, Psychology
Dennis Wall, Medicine
Brian Wandell, Psychology
Tom Wasow, Linguistics
Christian Wheeler, Business
John Willinsky, Education
Sam Wineburg, Education
Terry Winograd, Computer Science
Jason Yeatman, Education

continued

mediaX Researchers and Visiting Scholars continued

The mediaX Distinguished Visiting Scholars

One group of regular mediaX participants were all-star, extraordinary scholars who served as informal advisors of strong and weak signals on the horizon and contributed global perspectives across a variety of sectors for mediaX programs. The mediaX Distinguished Visiting Scholars had a unique and critical role. These scholars, who came from a wide variety of backgrounds and with a diverse set of perspectives, were leaders in their fields, innovative thinkers, and known to push boundaries for themselves and encourage others to do the same. At varying times, this group served as inspiration, advisors, strategists, and champions. They challenged mediaX to engage with edgy topics of global importance and collaborated with mediaX to celebrate visionary scientists. They expanded mediaX's outreach through introductions and invitations. They were often pleased to share their wisdom and insights with mediaX members. Many thanks for their time and wisdom.

Dragan Boscovic
Scott Burns
Bruce Cahan
Douglass Carmichael
David Cavander
Elizabeth Churchill
Keith Coleman
Parvati Dev
David Evans
Marc Goodman
Walter Greenleaf
Marsali Hancock
Kendall Haven
Chuck House
Jenny House
Kimi Iwamura
Neil Jacobstein
Ted Kahn
Timothy Kasbe
Aman Kumar
Martin Lee
Ajay Madhok
Mei Marker
Davis Masten
Natasa Milic-Frayling
Peter Norvig
Greg Nuyens
Brian Pierce
Neerja Raman
Rick Rommel
Stan Rosenschein
Paul Saffo
Stephen Sims
Marc Smith
Mike Steep
Susan Stucky
Hiroshi Tomita
Van Ton-Quinlivan
Tracey Wilen-Daughenti
Esther Wojcicki
Gary Wolf

Visiting Scholars to mediaX

Elizabeth Arredondo, Catalia Health
Rahul Basole, Accenture
Jaeyoun Cho, Samsung
Haisong Gu, Konica Minolta
Yuki Higuchi, Konica Minolta
Jukka Huhtamäki, Tampere University of Technology
Joris Jansen, Philips
Ikuko Kanazawa, Konica Minolta
Maurits Kaptein, Philips
Keiko Katsurazawa, Nissan
Kyu Sub Kwak, Samsung
Young Yoon Lee, Samsung
Tammy Lee, Samsung
Angela Liang, Acario Innovation
Kenji Masaki, Konica Minolta
Tommy Maatta, Philips
Toshiya Okamura, Tokyo Gas Company
Masahiro Ozawa, Konica Minolta
Neil Rubens, Visa
Kiyoshi Sakamoto, Konica Minolta
Kaisa Still, University of Oulu
Markus Strohmaeier, Graz University of Technology
Daisuke Takahashi, Konica Minolta
Kishio Tamura, Konica Minolta
Karen Wang, Wisdom Academy
Weina Wang, Guangzhou Qitian Technology Co., Ltd.
Lisa Watanabe Natsume, Tokyo Gas Company
Erin Young, University of Oxford
Haibo Zhang, Guangzhou Qitian Technology Co., Ltd.

2018 meeting of the mediaX Distinguished Visiting Scholars
Front Row: Elizabeth Wilsey, Jenny House, Neerja Raman, Martha Russell, Karina Alexanyan, Susan Stucky and Addy Dawes
Back Row: Bruce Cahan, Walter Greenleaf, Neil Jacobstein, Keith Devlin, Chuck House, Peter Norvig, Greg Nuyens, Kimi Iwamura and Esther Wozcicki.

Greg Nuyens, David Evans and Bruce Cahan at the mediaX 2018 Member Appreciation Event.

APPENDIX 9

Sample Job Announcement for Director of an Industry Affiliation Program

A qualified leader will have experience in both industry and academia, as well as an interest in bridging these with diplomacy. Foundational science background and vigorous curiosity are required in the area of intended discovery collaborations, and interests in the ethical and humanizing considerations of socio-technical applications are a plus.

Specifically, the applicant should be capable in these areas:

Relationship Cultivation

- Select and maintain relationships with corporate member liaisons.
- Recruit and retain paying members so the program meets financial goals.
- Dedicate time to build mutually beneficial human relationships.
- Understand and identify needs and potential points of shared interest among parties, recognizing essential differences in timelines, performance indicators and sources of income (grants, memberships and gifts).
- Be able to create the shared expectation of openness to asking questions, studying challenges and identifying insights for reciprocal corporate and academic benefit.
- Cultivate a multidisciplinary kaleidoscope of experts and connect people and ideas to spark synergy and enhance synchrony.
- Cultivate a sense of psychological safety and orchestrate interactions so participants understand and respect differences of culture and of language use.
- The right candidate will have an inclination to start with a "Yes, let's try it and see where it goes" and be able to inspire others to have that positive view.
- Foster engagement opportunities that stretch beyond the obvious and pull people from their research comfort zones to encourage creativity and exploration beyond the boundaries that limit perspectives.

Project Facilitation and Administration

- Manage funds in accordance with rules of host and member organizations.
- Identify and help implement opportunities to make the boundaries between academia and industry porous.
- Know or be willing to learn the protocols for privileged information in corporate and academic worlds.
- Give clear orientation to members so that they know the goals and principles of all engagements.
- Remain flexible to personnel changes in the corporate world while supporting the continuity of academic research projects.
- Find ways to bring together participants from around the world, for example using Zoom and virtual world applications.
- Streamline decision-making and administrative work to allow the maximum funding for research projects and to avoid creating bureaucratic roadblocks.
- Embrace a willingness to experiment and acknowledge learning alongside collaborators.
- Translate topics and themes into Requests for Proposals (RFPs) that are suitable for academic research and publicize these opportunities.
- Evaluate and recommend suitable Research Themes for RFPs, stimulate proposals responses for funding and set expectations for recipients.
- By stimulating their curiosity, convince experts that it is in their interest to help translate industry pain points and questions into valid Research Themes that are interdisciplinary and that invite scientific curiosity appropriate to sustain the interest of both business and academia stakeholders.
- Emphasize that the autonomy of university research promotes the best interests of both parties and maintain "dual agency" for both industry and university objectives.
- Coordinate events of varying time and intensity to cultivate relationships over time: seminars, dialogue groups, multiday conferences and webinars, as well as frequent emails and letters as appropriate.
- Identify obstacles and move beyond them by revealing shared questions and the opportunities they present.
- Build a network of campus administrators and corporate gatekeepers who can help get things done.
- Debrief and update participants regularly, keeping reporting requirements to a minimum.

continued

Sample Job Announcement for Director of an Industry Affiliation Program continued

Recognition

- Celebrate errors and failures by sharing what was learned in the process.
- Offer generous and visible compliments to partners on their successful achievements.
- Curate and disseminate summaries of research projects and prepare drafts for review when Principal Investigators are too busy or not inclined to create their reports.
- Pass credit to collaborators. Be comfortable not seeking to claim credit for self or the organization.
- Prepare and circulate summaries of meetings and presentations for circulation in member organizations, making modifications as requested by presenters and participants who have not provided original information.
- Recognize and appreciate the network of administrative staff who get things done.
- Encourage and celebrate the work of graduate students and their faculty mentors, as well as the mentoring roles of corporate participants.

Additional skills and qualifications anticipated for future Directors may include:

- Cultivate and retain members with varied organizational structures and sizes.
- Develop and implement processes for onboarding for new members without face-to-face contact.
- Provide events in multiple formats, including those not requiring physical presence of speakers or participants.
- Create and manage digital networking opportunities for academic and business affiliates.
- Adapt engagement platform to accommodate changing corporate structures, employment patterns and outsourcing patterns.

Image Credit: Linda A. Cicero / Stanford News Service

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