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Fusion: Cross-Domain Research on Cross-Domain Innovation

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Abstract

Cross-domain integration is a powerful approach to innovation. This paper presents an initial model of cross-domain innovation at the individual level and shares early insights from the first four participants in a qualitative, exploratory study. The model includes outward and inward openness, collecting (knowledge, skills, technologies, contacts, etc.), needs-sensing, and fusing (integrating ideas, methods, etc. from different domains into a new high-impact innovation). Early insights are shared from four world-class innovators, and reflections are offered on the research design and process – itself a cross-domain innovation.

Keywords: innovation, creativity, interdisciplinary, cross-domain, qualitative exploratory research

"Innovation opportunities going forward will be at the cusps of different disciplines – biology and computer science, information technology and health care, semiconductors and medicine."
-- Richard Newton, the former dean of engineering at the University of California, Berkeley (Mitra, 2009)

"The most innovative solutions to problems have come from the cross-pollination of fields."
-- Neil deGrasse Tyson, astrophysicist (Beard, 2015)

1. INTRODUCTION

The spaces between domains are fertile ground for high-value innovation. We see it in history (e.g. the Renaissance - Johansson, 2006); the generation of new fields (e.g. biotech and medical informatics); as well as new organizations like Harvard's iLab, created to support and encourage collaboration across schools. At the University of California, for example, public-health-innovation students gain skills in systematic innovation on domestic and global health projects with client organizations by working in small, cross-domain teams that may include domains such as epidemiology, city planning, and mechanical engineering (Sandhu, Hosang & Madsen, 2015). To address world problems, we need to integrate across domains.

We also see high-value innovation in amazing individuals who have spanned multiple domains and drawn from each to create something new and unique. Indeed, at the heart of history, fields, and organizations are individuals, and in this age of internet-accessible information, global communication/collaboration, start-ups, and start-up ecosystems, a good place to start understanding and encouraging cross-domain innovation is the individual. They are more likely than ever before to create innovations outside of established institutions, as well as creating new organizations, fields, and recorded history.

This paper introduces a new study on the conditions and mental processes of world-class cross-domain innovators. It is partly about cross-domain innovators and partly about research methodology, sharing early insights from the exploratory phase of a qualitative study.

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To clarify the choice of terminology used here, "discipline" generally refers to an academic body of knowledge. "Field" generally refers to an area of practice. I've chosen the term "domain" used by Csikszentmihalyi (2013), which denotes a set of knowledge, tools, values, and practices - not restricted to an academic discipline or a particular field of practice.

2. THE FUSION STUDY

The Fusion study addresses two basic research questions:

1. Why and how do world-class cross-domain innovators innovate?
2. Why do others in the same circumstance not innovate? (or what makes the innovators "different"?)

Answers may help other individuals become cross-domain innovators, as well, and may form the basis for team processes and company systems, in order to encourage more of the same at the team and organizational levels. This depends, of course, on the assumption that cross-domain innovation is not an in-born/inherent trait. Since creativity and innovation are routinely taught to individuals and teams, and since organizations regularly create processes and structures for innovation (including cross-domain), this assumption seems acceptable.

2.1 Foundations

The foundations of the study arose from both practice and literature review (a fusion of industry and academe). Regarding practice, I bring observations and experience from two decades of cross-industry, cross-national, cross-functional consulting and entrepreneurship. For example, one of the consultancies I worked for started eBusinesses in the early days of eCommerce (back when no one knew what to call it yet), and all of our teams integrated the perspectives and skills of design, technology, and business (which also happens to be the integration achieved with design thinking, a highly productive approach to innovation). Our firm built eBusinesses for Chase, Sephora, Boots, Marubeni, and many others. While there, I co-founded an innovation lab in Singapore, at which we created new initiatives out of the intersection of different industries, functions, and technologies, in business and government, across nations – in short, across multiple domains.

2.2 Model

I could see there was something special and highly productive in domain integration. When I re-joined academe 20 years after my DBA at Harvard Business School in IT & International Management (cross-disciplinary, of course), I created an initial (or "going-in") model with the threads I had pulled and picked through over the years – a set of key elements in a process (see Fig. 1).

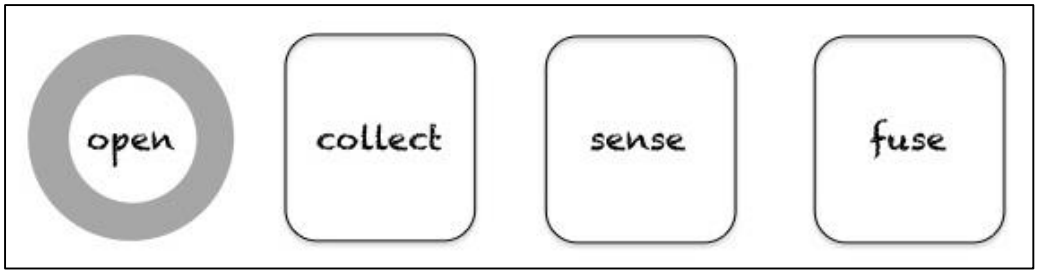

Figure 1: Fusion – the initial model.

Basically, with the end-result of fusing pieces from two or more domains into a new, useful creation, I recalled key elements that seemed to feed into a fairly common process. The first three steps are not necessarily sequential, so I have not drawn arrows between them at this point.

2.3 Openness – outward and inward

It begins with openness to outside influences – perceptiveness and awareness. I've noticed and read over the years that creative individuals are very open to what is around them – new ideas, diverse conversations, tools & technologies, etc. Indeed, the Center for Creative Leadership (David & Buchner, 2014) identified awareness as one of the 6 key innovation-leadership thinking skills. Innovators and great leaders are "first-class noticers"

(Bazerman, 2014). For example, Mr. Matsushita (founder of Matsushita Electronics) was not only open to a never-ending flow of new ideas and technologies from outside his company, but by habitually talking to everyone at every opportunity, he routinely astonished his staff by knowing things they had no idea he knew -- often key managerial issues. If a meeting was late, he was likely to be found on his knees talking (and listening) to an electrician fixing the meeting room plugs (PHP Research Institute, 1994). He even introduced his personal assistant to the concept of pillow fronts and backs by telling him whenever they were leaving a room with the zippered side forward. He was curious, listened, and noticed it all.

Inward openness appears to be just as important – the ability to hear inspiration clearly and build on it. Inspirations have been described as coming from "within," God, The Universe, the subconscious, etc. Regardless of the source, inspiration seems to be experienced as an individual phenomenon (not social) and can occur in a variety of circumstances -- during or after meditation, exercise, a retreat or vacation, in the shower, when seeing Tonka toys while in bed with a cold musing on the structure of DNA (Watson, 2001), etc. Csikszentmihalyi describes such events as coming after a period of "incubation" while doing something else like swimming, walking, or going on vacation. Indeed, there is research on the impact of walking on creativity (Oppezzo & Schwartz, 2014). Maintaining a state of inward awareness and regular practices to promote it seem to foster creativity.

2.4 Collecting

Before fusing ideas, technologies, people, methods, designs, etc. from different domains, it is obviously necessary to possess such building blocks from different domains or at least possess from one domain and enter another with a "different perspective." Some innovators collect knowledge and skills out of curiosity and then find a use for them (e.g. Karen Stephenson, CEO, corporate anthropologist, and social network modeller, who began her education studying art and quantum chemistry). Some find a need and then collect. Martine Rothblatt, for example, while taking a break from undergraduate studies in communication, created a vision to use satellite technologies to unite the world. She later earned an MBA, became a regulatory attorney, studied astronomy, worked in satellite and communication regulation, and served as CEO of GeoStar Corporation (among other accomplishments) before founding SiriusXM (satellite radio). Sirius introduced satellite technology into the radio industry and now earns over $4 billion/year in revenue. She was deeply grounded in communications, business, law, and satellite technology and brought them together in an integrative way.

2.5 Sensing

Sensing a need or opportunity is the key catalyst for fusing, and there are two basic motivators: vision/opportunity (pull) and need (push). Each of these can be one's own need or someone else's. Drawing again on Martine as an example, SiriusXM was born out of a vision. United Theraputics, on the other hand, grew out of her entering the pharmaceutical domain for one purpose – to save her daughter's life. She developed a drug that did that, offered it to others, expanded operations, and now UT is valued at over $3 billion. Openness is necessary for need-sensing but not sufficient. When a need is sensed, it must also be defined or framed. At IDEO, for example, "frame opportunities" is a particular step in their design thinking methodology, whereby the desired state is defined. The approach is useful for handling "wicked problems" in which both the problem and the solution must be discovered. Needs must also be evaluated for potential impact – deep (e.g. saving a life), broad (e.g. facilitating millions of communications), or both.

2.6 Fusing

Once a need is sensed, framed, and evaluated, an innovator may act or dismiss the opportunity. Fusing – the final step – is the act of integrating something (need, idea, technology, design, etc.) from two or more different domains. Having skills or interests in disparate domains is one thing (doctor by day, technology geek by night), but to integrate them into something new and useful is the critical act that creates value and sometimes creates whole new domains (e.g. medical informatics).

2.7 Cross-domain literature / Cross-domain research

Once these themes or elements were defined based on practice, literature review was the next logical step. Were there existing models that would help people understand and improve their capabilities in these areas? My beleaguered research assistant did not find a unified theory that covered all of this, and most of the writing on interdisciplinary work has focused on identifying barriers and difficulties or espousing the need for more.

However, we did find separate domains and bodies of literature that can provide a solid foundation for various elements. Creativity and individual-level innovation literatures underlie the process as a whole (Csikszentmihalyi, 2013; Amabile, 1988). External openness or awareness can draw on leadership and "noticing" works (Bazerman, 2014), as well as inattentional blindness (Simons & Chabris, 1999). Mindfulness is a rich literature to draw on for internal and external openness (Shapiro, Carlson, Astin, & Freedman, 2006). Design thinking and empathy (including cognitive, affective, and active) provide a foundation for needs sensing (Suri & Hendrix, 2010). Fusing will draw heavily on integrative thinking (Martin, 2009) as well as decision science, e.g. problem framing and problem solving (Moldeveneau & Leclerc, 2015). Ironically, in drawing from the scattering of disciplines above, which crosses the fields of psychology and business, the current study is itself cross-domain.

3. METHODOLOGY

Assuming it would be useful to have a good model of cross-domain innovation, and seeing that one does not exist, the next step should be exploratory research to begin creating one. The initial model is just that – a baseline to guide exploration, looking for new themes and ideas to emerge and improve the initial model or contradict it entirely and form the basis of a completely new one.

For research design inspiration, I drew from an old favourite in terms of writing and research process, *In Search of Excellence* (Thomas & Waterman, 1982). It also happens to be one of the biggest selling in the field of business (over 3 million copies sold in its first four years), suggesting it has been a useful work, as I would like mine to be. The authors chose 43 companies in a variety of industries that displayed what they wanted to investigate, collected data on them in multiple ways, and searched for themes. Csikszentmihalyi (2013) interviewed over 100 highly-creative people and drew patterns from the rich qualitative data he collected.

However, these were finished works. Did I have to study 43 – 100+ innovators for the exploratory phase of Fusion? For this question, I drew from the design thinking methodology I teach (from IDEO + ExperiencePoint), which is basically qualitative research applied to product/service development and complex problem-solving. In design thinking, we generally see patterns after about 10 participants. This is similar to the advice of Baker & Edwards (2012) to interview about a dozen participants when exploring a topic relatively familiar to the researcher. So, Fusion's exploratory phase includes 10 participants, to be followed by analysis, model refining, and design of the remainder of the study.

To gather rich enough data on the participants, I decided to "shadow" them for a day and interview them in a free-flow, natural manner, yet with an interview protocol (set of questions) to cover the research questions and the initial model. The comprehensive-conversation approach is similar to Csikszentmihalyi (2013). Notes would be taken during the day, documents and/or videos gathered (for triangulation), and in order to address the "why didn't others innovate" question, I will also interview people (with another interview protocol) who worked with the innovator, especially those who were there at the time of innovation, if possible. The fusion-friends interviews (at least 3 per interviewee where possible) also provided an outside perspective on the innovator (triangulation, again).

Similar to Csikszentmihalyi (2013), I had a great deal of difficulty finding initial participants. To be relevant to the study, and in keeping with the design thinking approach, I wanted to study extremes because they "give voice" to differences and insights more easily than those in the mainstream. That meant finding people who both (1) integrated across domains (the more diverse the better) and (2) generated innovations that were highly valuable (inventors, CEO's, founders of fields, etc.).

Initial attempts to find such people in the media were time-consuming, and attempts to get them to join the study were completely unfruitful. I realized that I wasn't fusing my own career. I spent 20 years working with innovative people and had created some innovative enterprises myself. Surely I had a network to draw on.

What if I shadowed and interviewed people I knew? That made all the difference. As a researcher, it would be nice to take a random sample of Nobel laureates, inventors, and founders, but it's rare for someone to let a stranger into their lives for a day. By interviewing people I know, I introduce a bias, but perhaps interviewing extraordinarily-welcoming strangers would provide a bias, as well. Once interviewed, my participants have been willing to refer me to others, so my enlarged sample will include people I don't know (the "snowball" effect per Csikszentmihalyi, 2013). Further, my understanding of the early participants is greater since I've known some of them for 10 – 20 years.

Table 1 shows the 10 participants identified (and not identified) for this exploratory phase. The first four have been conducted. For well-known innovators I cannot shadow, I will read about them and view publicly-available interviews on the Internet. (Seventeen have already been identified.)

Table 1: Exploratory-phase participants.

Innovator	Job	Integration	Impact
Sister Cyril Mooney	Nun-Educator-Consultant	Rich & poor, fee-based education & social work, different castes (India)	Founded education-and-social-work programs that impacted 450,000 children and family members
Dr. Karen Stephenson	Corporate Anthropologist, Founder & CEO	Art, quantum chemistry, anthropology/ethnology, mathematical modeling, software development	Pioneer in social network analysis, founded Netform, which CIO magazine called "one of the 100 most innovative firms in the world."
Asil Toksal	Biofuel & Digital-Marketing Entrepreneur	Eco- & fuel, design-digital-business	Founded the largest biofuel company in Austria, founded a pioneering company in digital marketing
Dr. Edy Greenblatt	Leadership Educator & Dance Ethnologist	Dance, ethnology, organizational behavior, leadership & group dynamics	Created groundbreaking programs that have impacted hundreds of leaders, e.g. team dynamics on trapeze
Sean Lees	Cross-Industry Digital Entrepreneur	IT, marketing, distribution, across multiple nations	After selling his dot-com enterprise that integrated 2 industries, took charge of an international marketing enterprise with 4,000 people to manage
Super-premier Hotelier	Chairman, CEO, Founder, Designer	Home, hotel/resort, history, rich-poor, art/design & business	Founded an enterprise worth hundreds of millions of dollars that hosts the world's super-wealthy and gives them contact with the world's historic sites and super-poor populations
Fusion Musician	Fusion Musician-Producer	Multiple domains of music, business management	Creates musical productions at the forefront of the fusion music genre
A*STAR Scientist	Interdisciplinary Science Commercializer	Interdisciplinary science and technology, business (start-up)	TBD
A*STAR Scientist	Interdisciplinary Science Commercializer	Interdisciplinary science and technology, business (start-up)	TBD
"Snowball" Participant	TBD	TBD	TBD

4. EARLY INSIGHTS ON FUSION

The first four participants have been shadowed, interviewed, and colleagues interviewed. Data is not yet transcribed, coded, and processed, however I would like to share a few early insights, themes, and patterns. For the sake of brevity, I've selected a few that I find most interesting.

4.1 Openness – Outward

Kolkata can be an overwhelming experience to a visitor. When walking down the street, there are a million things to see – hundreds of people of all different kinds, sidewalk sellers, vehicles, and many years ago, animals, too. One of my most abiding memories of India was of streets filled with buses, bicycles, Mercedes, old-fashioned Marutis, donkey-drawn hay carts, human-pushed wagons, goats, cows, bulls, dogs, and humans of every description doing everything imaginable. The only way to handle the overwhelming, exhausting stimulus (including the heat, cold, smell, sound, etc.) was to filter it out.

Not only do we naturally filter our environment when over-stimulated, we also filter when we're busy and focused (see Simons, 1999 on inattention blindness). So, when we're focused on a job to do, we may not be open to opportunities just outside our span of attention.

Enter a young Irish nun, tasked with teaching science at the Loreto Sealdah School, which provided a highly-respected, elite, fee-based Catholic education. She eventually worked her way up to principal, and to help her students grow in empathy and social responsibility, she led her class in a community project reaching out to poor children. They didn't need to look far. Only 300 metres from the front door, poor children were living with their families under a bridge. At that point, she asked herself, "My God, what am I doing here?" She couldn't continue educating only the elite group of children in her care while schoolless children resided just outside the door. She clarified her mission – the lens through which she would see the world for decades to come – as, "We educate children." With that lens on the world, she began to see children everywhere who needed an education and opened her doors to them, ultimately starting an array of social-work-and-education programs that benefitted 450,000 children and family members among the world's poorest populations.

By creating the right filter, you can remain open in the area you choose. But the filter itself needs maintenance and bounding. When a poor child found her way to Sister Cyril's school, Sister asked the mother if she'd like the child to stay as needed, sleep, and go to school, and the mother said yes. Sister did not didn't expand her lens to housing the mother. Having a lens allows you to remain open to what comes through the filter, and it also helps with saying no to what is outside the filter.

As a final note to outward openness, more than one interviewee has mentioned that two directions are involved: (1) what comes in to the innovator (ideas, contacts, resources, etc.) and (2) what goes out from the innovator. The interviewees said that something different about these innovators is that when then open up and give, they give everything – thoughts, ideas, emotions, helpful actions – all of themselves, and that professional and personal are integrated. An open person is porous, and like a sponge, "water" goes both in and out.

4.2 Openness – Inward

Sister Cyril decided to become a nun after three days of intensive prayer. Her daily life as a nun begins with spiritual practices such as mass and prayer. Asil is highly spiritual and takes time daily for meditation, as well as going on retreats to learn more from Buddhist monks, shamans in Peru, etc.

Edy exercises daily and calls her lap-swimming time a "staff meeting" of the various voices and thoughts in her head. She works out problems while swimming and afterwards likes best to return to her office and without a word to anyone enacts what she's worked out in her mind. Water aerobics, however, does not give her the same internally-focused, internal "flow" time because her attention is directed outward, not inward.

Openness to internal inspiration is absolutely essential to the creative process, and different people maintain their inward porosity in different ways.

4.3 Collecting

The moment Asil saw me taking interview notes in shorthand, he wanted to learn shorthand. When I shared my background with him, he started thinking about getting a DBA also, and shared with me that he has quite a number of unfinished degrees, plus some finished ones, e.g. a master's degree in computer science. Why not finish the degrees? He said when he got out of them what he wanted ("the good stuff – the interesting learning and the essence of the field"), he didn't need to finish.

Karen studied art and quantum chemistry at the undergraduate level, which raised a few eyebrows. She said people wanted to know what she was going to do with those degrees, and she replied, "This is a liberal arts college. Can't I just take what interests me?" Underlying both disciplines was something in which she is uniquely gifted -- pattern matching. She had a unique ability to identify painters from their works based on the brush strokes. In quantum chemistry, she found the patterns of molecular-chemical behaviour intriguing. When she took charge of a chemistry lab, she looked down on the floor of chemists one day and recognized a common pattern of chemical reactions in the way people were interacting.

Having seeing the pattern in the chemistry lab, she decided to investigate and studied mathematical modelling, anthropology, sociology, and more in order to collect the perspectives, methods, and tools with which to understand this phenomenon. One of her professors told her she was all over the place and needed to focus. Her response was, "Huh? I'm focused like a laser beam on this one phenomenon."

Here we see (1) collecting before a vision is created due to interest/curiosity and (2) collecting afterwards in order to explain a phenomenon or address a problem.

4.4 Sensing

When Sister Cyril sent out her students to find malnourished children living under a bridge, they returned, saying, "No, they're all quite fat." They weren't aware of the swelling of the body that occurs in the latter stages of malnutrition and so couldn't see the poor children around them. Sister, herself, while she was focused on educating paying students and running a school hadn't sensed the needs of children just outside the school doors.

Once the students learned about malnutrition, and once Sister ventured beyond her door, they sensed needs around them and continued to sense and investigate. By knowing what you are looking for, you can see and understand. By beginning to act (as Sister Cyril did by starting programs and taking initiative without resources or permission), opportunities and resources come through our lens on the world.

4.5 Fusing

I found it most remarkable to see that these cross-domain innovators didn't recognize or care that their creations were across domains. They either did not recognize they were crossing boundaries or did not care. When Sister Cyril saw children sleeping under bridges and an empty school, she opened her doors and invited them in, thus taking the first step towards 35 years of creating education-social programmes. Karen had a phenomenon to investigate (quantum social dynamics), and the relevant pieces for understanding it happened to be in different domains. Edy had a problem to solve – burnout among care-giving professionals – and the tools for understanding and managing energy lay in neuropsychopharmacology, dance, ethnology, organizational behaviour, and more. Asil saw opportunities to create good in the world and did so. One enterprise bridged ecology and fuel production; another operated at the forefront of digital marketing, at the intersection of design, technology, and business.

Having a cross-disciplinary background enabled these four individuals to recognize a phenomenon, problem, or opportunity in a unique way. Once identified, it was natural for them to pursue it with a cross-domain approach that yielded unique solutions with great impact.

4.6 Overall

A few more observations are worth noting. Once of the interviewees mentioned something I suspect: crossing one domain makes you more likely to cross more. None of these four innovators integrated only one domain. Sister Cyril integrated religion-education-social-work, different castes, and rich-poor in her school. Karen crossed art-science-technology-anthropology-sociology-business and more. Edy crossed dance-ethnology-business-medicine-anthropology and more. Asil crossed eco-fuel-production-design-technology-business and more.

All of them so far (and the others identified but not yet interviewed) are international. Sister Cyril is Irish but has worked and lived in India for most of her life. Karen lives in the US and Spain, and I caught her just before working in The Netherlands and Germany. She travels 345 days a year. Asil is Turkish raised in Austria, working and living in the US (two homes), Austria, and Singapore. Edy lives in the US and Israel and works in Canada and around the world. Multiculturalism may be connected with cross-domain creativity, and indeed, there is research connecting bilingualism, biculturalism, and psychological androgyny with intelligence, health, happiness, and adaptability (Leora 1982).

5. EARLY INSIGHTS ON THE QUALITATIVE-EXPLORATORY JOURNEY

Although I had planned to shadow innovators for one day, one of them had me shadow in two countries. She said there was no way I could understand how she creates if I don't see both the place where she lives and fills up on energy as well as the place where she delivers and solves problems. I extended my observations of her, and it might be necessary to expand my observations of others wherever possible. In addition, all of them said they do not have "typical" days, so just come and see something. Is lack of "typical" part of the creative life?

I chose Sister Cyril because of her integrative education model (rich-poor, multi-caste, older kids leading younger kids, etc.). However, once I started listening to her life's work, I found a much bigger story – the 14 other education and social programs she founded. Part of the power of qualitative exploratory work is finding something bigger to investigate.

My subjects are more "normal" than Csikszentmihalyi's (2013) Nobel laureates. To be honest, I'm not going to be able to get strangers to agree to participate in my study. However, by studying more "normal" people, I remain closer to a motivation at the heart of my research – the desire to inspire anyone who wants to create world-leading innovations. By studying common people who became uncommon, perhaps it will be easier to connect and inspire.

6. CONCLUSIONS

I've learned a great deal from just the first four participants. They have taken a vague initial model and are clarifying, deepening, and building on it, as well as providing additional insights and themes of which I was not aware. I am learning much and look forward to sharing with others what I am learning in this rich and unique way.

When faced with difficulties getting started, I had to return to recognizing the resources and capabilities I already had and doing what I can with what I have. From that I will build, but only with the help of those I study. Although I design, lead, travel, and listen, in some regard this study is not my own but a sharing, creation, and integration among master sharers, creators, and integrators.

I am honoured.

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