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Different Shapes, Common Patterns: Emerging Approaches To Teach Innovation Within Higher Education

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Introduction

One goal of higher education should be the preparation of students for current and future requirements to function as effective professionals and engaged citizens. This mission is tricky in an unpredictable world. A variety of emerging methods in higher education seek to prepare students to navigate a world of fast churn and high uncertainty. Different approaches warrant closer evaluation and comparison in how they train individuals to better understand, adapt to, and enter this new environment. Although various offerings have different naming conventions and formats, emerging methods nonetheless share many common threads. These university programs promote prized 21st Century skills such as creativity, collaborative teamwork, familiarity with innovation methodologies, and an entrepreneurial mindset.

On June 11, 2015, Silicon Flatirons Center hosted a roundtable titled "Emerging Shapes of Higher Education" (the "Roundtable") to discuss efforts to create adaptive and flexible professionals in a world of innovation and rapid change. The Roundtable examined popular educational programs such as training T-Shaped Individuals ("T-Shapes"), Design Centered Thinking, Lean Methodology, and cultivating an Entrepreneurial Mindset. Participants included notable scholars, entrepreneurs, and others interested in higher education effectiveness. The resulting discussion forms the backbone of this report (the "Report") which is augmented by additional research and post-Roundtable input from participants.

Cataloging and comparing these new pedagogical methods is daunting since many offerings span across a variety of disciplines and utilize a different lexicon to describe their core objectives. Surveying this landscape, Roundtable participant Libby Cook highlighted the need for successful programs to "open source" their methods to better identify what works and to make quick iterative changes on what does not. This Report seeks to bolster this goal by focusing on common concepts, patterns, and approaches that occur across these methods to make them mutually intelligible.

At least three broad trends create the context against which these new approaches oriented around innovation arise. These drivers provide impetus for new methods discussed at the Roundtable.

First, specialization led universities to create silos. The Scientific Revolution made the world more complex. When the scientific method became widespread during the 17th century,[1] discoveries allowed societies to live longer and healthier, shorten travel times, and better understand the world around them. As the scientific discovery loop shortened, it led to an exponential growth in scientific knowledge. Ensuing generations of scientists began to specialize in particular fields and subfields.[2] Sam Arbesman, Senior Adjunct Fellow at Silicon Flatirons Center noted, "certain aspects of our world became so complex that we no longer understood them." As this trend continued, specialists became experts in narrower fields. Arbesman explained that society "made sense of our world by dividing information into manageable portions and distinct areas of proficiency."[3] In the higher

[1] *Scientific Method*, WIKIPEDIA, https://en.wikipedia.org/wiki/Scientific_method (last visited July 31, 2015).
[2] Sam Arbesman, THE HALF-LIFE OF FACTS: WHY EVERYTHING WE KNOW HAS AN EXPIRATION DATE 24 (2013).
[3] Sam Arbesman, *Let's Bring the Polymath—and the Dabblers—Back*, WIRED (Dec. 13, 2013, 9:30 AM), *available at* http://www.wired.com/2013/12/165191.

education setting, the modern research university featured faculties organized around specialization.[4] This model remains dominant today. The "siloing" of information remains a hallmark of most universities. Notably, as innovation becomes more imperative, however, hyper-specialization can be a hindrance. New ideas often come from adjacent areas and cross-disciplinary collaboration enabling individuals who are "cognitively proximate" to multiple perspectives the ability to recognize them easier.[5]

A second driver favoring heightened emphasis on flexibility and adaptation is the economic shift into an information age. Massive increases in computing power during the Digital Revolution created an enormous amount of data and new sets of tools.[6] Much of the world, especially in developed nations, shifted to an economy dominated by information services.[7] Employers now focus on hiring individuals who are prepared to face a rapidly changing digital world. In order to best meet these demands, higher education must offer programs that produce individuals who are comfortable working with and manipulating the latest technology. These individuals will be in a prime position to contribute to new innovations.

A third imperative for higher education to reinvent is universities' commoditized, "one-to-many" delivery of knowledge. Government funding for universities has steadily declined since the 1980s, despite a coinciding increased demand for higher education during the same period.[8] This overall effect triggered, as Warren Binford put it, institutions to seek "the most cost efficient way to deliver the product to the recipient." This led many universities to increase class sizes, rely more heavily on part-time or adjunct faculty, and accordingly, focus less on individualized student training. One-to-many models of education, where students are passive receptors of information from a central expert, work in some contexts, but fall short when teaching innovation and the ability to adapt. Emerging programs that emphasize innovation address these limitations by prioritizing experiential and active learning, often in team-based settings.

With these factors serving as a backdrop, the Roundtable identified trends across popular programs seeking to teach students to be adaptable and innovative. A major theme of the Roundtable was the goals of these programs which broke neatly into two distinct categories. The first is the skills and capabilities that they seek to impart upon students. Of these, the most discussed were: being equipped for a world of rapid change; possessing broad cognitive proximity; preparedness to collaborate with others; comfort with the latest forms of technology; and being able to unlock creative potential. The second category is new attitudes that these programs attempt to cultivate within students. The common ones that emerged during the Roundtable were: empathy; favoring a network perspective over a hierarchical one; possessing a growth mindset; and being open to new motivations for action.

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[4] *See* CHAD WELLMON, ORGANIZING ENLIGHTENMENT: INFORMATION OVERLOAD AND THE INVENTION OF THE MODERN RESEARCH UNIVERSITY (2015).

[5] *See* MYSTERY MURPHY, SILICON FLATIRONS CTR., BOUNDARY JUMPING: UNDERSTANDING THE VALUE OF MODEST ANARCHY IN ENTREPRENEURIAL NETWORKS (2014), *available at* http://www.silicon-flatirons.org/documents/publications/report/201401BoundaryJumpingReport.pdf.

[6] *See* Gordon E. Moore, *Cramming More components onto Integrated Circuits,* ELECTRONICS MAG. (Apr. 1965); *Digital Revolution*, WIKIPEDIA, https://en.wikipedia.org/wiki/Digital_Revolution (last visited July 31, 2015).

[7] *See e.g.,* Michael Urquhart, *The Employment Shift to Services: Where did come from?,* BUREAU LAB. STAT. MONTHLY LAB. REV., Apr. 1984, *available at* http://www.bls.gov/opub/mlr/1984/04/art2full.pdf.

[8] *See* Thomas G. Mortenson, *State Funding: A Race to the Bottom*, AM. COUNS. ON EDUC. *available at* http://www.acenet.edu/the-presidency/columns-and-features/Pages/state-funding-a-race-to-the-bottom.aspx (last visited July 31, 2015).

In order to best deploy these skills and new attitudes, various pedagogical methods were also compared. Of these, six were commonly utilized by the programs discussed: individualizing the student's educational experience; better aligning students' incentives with the goals of these programs; team-based opportunities; experiential learning; bringing community into the classroom; and providing a structure where ongoing engagement continues to keep the student stimulated.

Finally, the Roundtable discussed various challenges that might inhibit these programs' success. Within the university system these challenges seemed most prominent with regards to resource constraints and existing incentive structures for both teachers and students. Some challenges within the corporate realm were also identified. Alongside many of these the Roundtable suggested potential solutions for confronting these challenges.

This Report proceeds in four sections. Section I identifies the programs discussed during the Roundtable. Section II examines commonalities across these programs in spite of different names and (literally) different shapes and sizes. This section places particular emphasis on the programs' common desired outcomes. Within these characteristics, interesting trends can be seen with the types of attitudes and skillsets sought to be cultivated. Section III identifies various methods for producing these outcomes. Clear similarities exist here as well. Finally, Section IV looks at some of the challenges to deploying these methods and programs as well as some potential ways to alleviate them.

The set of emerging educational initiatives discussed in this Report are encouraging and offer educational leaders promising guideposts on the road for improving the experiences of the students looking for training in a 21st century economy. Educators seeking to train adaptable, flexible, and innovative minds are somewhat like the blind men in the Blind Men and Elephant parable,[9] feeling their way through an uncertain area of education. Accordingly, this Report only aims to provide a high-level analysis in piecing together multiple threads seen within these programs. Hopefully, the work contained within can provide a jumping off point for more specific work in the future.

I. Educational Programs in Innovation

Roundtable participants examined a variety of programs that seek to teach innovation, including T-Shapes, Design Centered Thinking, Lean Methodology, and training an Entrepreneurial Mindset. One of the pioneering efforts to cultivate innovation-minded workers is the T-Shape movement. A "T-Shaped individual" has a deep specialization in a certain area. From a conceptual standpoint, this comprises the "vertical bar" of the "T." She also has functional understanding of other disciplines. This is the "horizontal" of the "T" – i.e., the facility to communicate and collaborate effectively with other specialists in these disciplines. These individuals are thus able to "shape their knowledge to fit the problem at hand, rather than insist that their problems appear in a particular, recognizable form."[10] Although the term T-Shaped has garnered much attention in recent years, its roots trace to the early 1990s when IBM sought to identify the next-generation of managers

[9] https://en.wikipedia.org/wiki/Blind_men_and_an_elephant

[10] David Ing, *T-Shaped professionals, T-Shaped Skills, Hybrid managers,* COEVOLVING INNOVATIONS (Sept. 6, 2008), http://coevolving.com/blogs/index.php/archive/t-shaped-professionals-t-shaped-skills-hybrid-managers.

who could better handle solving problems in a service-based economy.[11] IBM continues to be a leader in pushing for the creation of more T-Shapes for a rapidly changing modern economy.[12] After helping assemble over 300 projects-based teams of T-Shapes, Dr. Bradford Brooks of IBM asserts that while they often have a natural desire to collaborate, their talents need to be cultivated and preserved. To do this, he believes it is integral to keep them challenged and surrounded by other T-Shapes. A common example of a T-Shape is someone who switched careers but continued to utilize prior skills in the new career.

Another movement that spans across multiple institutions is the emphasis on teaching Design Centered Thinking. Prominently featured in the Hasso Plattner Institute of Design at Stanford University — better known as the "d.school"— these methods focus on better understanding the human-side of problems to uncover latent creative solutions.[13] In seeking to inject design elements when solving problems traditionally viewed as technical, Design Centered Thinking strips away judgment from early proposed ideas, utilizes multidisciplinary teams to expand perspectives, and seeks to place oneself in the position of those affected by the particular problem. Once you can see a problem through the eyes of those affected by it, it taps into a different level of creativity to solve it. In describing how this might work in practice, AirBnB co-founder Joe Gebbia uses a hypothetical in the context of creating a medical device: "we would go out into the world . . . talk with all of the stakeholders, all of the users of that product, doctors, nurses, patients and then we would have that epiphany moment where we would lay down in the bed in the hospital. We'd have the device applied to us, and we would sit there and feel exactly what it felt like to be the patient, and it was in that moment where you start to go aha, that's really uncomfortable. There's probably a better way to do this."[14] In recent years, these methods have won the praise of various large corporations, with some concluding that it is the best way to find innovative solutions for individual-centric problems.[15]

Lean methodology principles ("Lean") were first employed on a large scale by Japanese auto manufacturer Toyota to minimize the risk and cost of testing a new venture. Steve Blank helped pioneer application of these concepts to startups.[16] Lean gained popular attention when Eric Ries, a former student of Blank's, detailed them in his best-seller *the Lean Startup* in 2011.[17] Today Lean is among the most common innovation methods. Lean provides a "how-to" template for entrepreneurs seeking to create innovative solutions. With a focus on quick experimentation, rapid iteration and the collection of meaningful feedback, many consider Lean as the most effective way to strategize before deploying an innovative solution in a world dominated by rapidly changing conditions. These concepts have certainly reached broad application, as Roundtable participant Sue

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[11] *Id.*

[12] TOM KUCHARVY, IBM'S ROLE IN CREATING THE WORKFORCE OF THE FUTURE, BEYOND IT (2009), *available at* http://www-05.ibm.com/de/ibm/engagement/university_relations/pdf/Beyond_IT_report_IBM_Workforce_of_the_Future.pdf.

[13] d.school: Hasso Platner Institute of Design at Stanford, *Fact Sheet*, http://dschool.stanford.edu/wp-content/uploads/2010/09/dschool-fact-sheet-2012.pdf (last visited July 31, 2015).

[14] *How Design Thinking Transformed Airbnb from a Failing Startup to a Billion Dollar Business*, FIRST ROUND REVIEW, http://firstround.com/review/How-design-thinking-transformed-Airbnb-from-failing-startup-to-billion-dollar-business (last visited Aug. 29, 2015).

[15] *See, eg.,* Tim Brown, *Design Thinking*, HARV. BUS. REV., June 2008, *available at* https://hbr.org/2008/06/design-thinking.

[16] STEVE BLANK, THE FOUR STEPS TO THE EPIPHANY: SUCCESSFUL STRATEGIES FOR PRODUCTS THAT WIN (2005).

[17] ERIC RIES, THE LEAN START-UP: HOW CONSTANT INNOVATION CREATES RADICALLY SUCCESSFUL BUSINESSES (2011).

Heilbronner remarked, Lean "is not just about starting a business, but can aid in tackling a multitude of problems in life."

Similar in many regards to Lean is the notion of developing an Entrepreneurial Mindset. At its core, possessing an Entrepreneurial Mindset prepares one for drastic changes to the status quo. Features include having a network perspective rather than a hierarchical one, being ready and willing to collaborate, possessing the skills needed to traverse conditions of uncertainty, and focusing on experiencing rather than planning.[18] As the value of the Entrepreneurial Mindset becomes more widespread, it is not uncommon to see various courses teaching students ways to apply entrepreneurial concepts to solve problems in all situations—and not simply in the context of starting a business. An example of this approach is well-documented in LinkedIn co-founder Reid Hoffman's *the Start-up of You*,[19] which Heilbronner pointed out is required reading in her Philosophy of Entrepreneurship course at the University of Colorado law school ("CU Law School").

The above is not an exhaustive list of programs seeking to teach innovation and nor does this Report attempt to identify all of them; rather, it merely seeks to highlight some of the prominent similarities across some of them. The need for this effort was underscored by an observation made during the Roundtable by participants Blake Reid and Zach Nies. Reid and Nies teach classes housed in different departments at the University of Colorado. Nies co-teaches Startup Essentials to undergraduate computer science students whereas Reid oversees the Tech Law and Policy Clinic at the law school. Nonetheless the two courses, despite differences in naming conventions and vast differences in subject matter, have much in common. As discussed below, the courses seek to instill many of the same qualities in students using very similar teaching methods. This comparison highlights the purpose of this Report – viz., to identify commonalities across numerous programs that teach innovation.

II. Common Elements of Programs Aiming to Teach Innovation

Co Barry, of CreatEdu, told of a word exercise she facilitated where various parties working around innovation described concepts, terms and outcomes. The results showed enormous polarity over the terms themselves. For instance, the concept of "entrepreneurship" carried a vastly different meaning from one subject to another. However, she noted an overwhelming amount of common ground when it came to defining specific outcomes. This led Barry to suggest outcomes is as a "powerful place to frame" the comparison of the various programs. Utilizing this framework, this Report groups common elements of these programs into three distinct categories—with the first two focused on outcomes. First, this Report looks at the skills and capabilities that each program seeks to impart to students. Next, it proceeds by identifying common attitudes the programs aim to instill. Lastly, to achieve these outcomes, the common pedagogical approaches employed are overviewed.[20] Each is examined in turn below.

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[18] Brad Bernthal, *Colleges Must Mix Entrepreneurial Skills, Traditional Liberal Arts*, XCONOMY (Jan. 14, 2015), http://www.xconomy.com/boulder-denver/2015/01/14/colleges-must-mix-entrepreneurial-skills-traditional-liberal-arts.

[19] REID HOFFMAN & BEN CASNOCHA, THE START-UP OF YOU: ADAPT TO THE FUTURE, INVEST IN YOURSELF, AND TRANSFORM YOUR CAREER (2012).

[20] Individual examples within one of these may seem to spill over into another category in certain instance, for example, some may consider a certain desired attitude a skillset and vice versa.

A. Skills and Capabilities

The Roundtable identified five skills and capabilities that most, if not all, innovation methodologies seek to cultivate within individuals. Specifically, methods most commonly discussed aim to better equip students: (i) to understand and react to a world of rapid change; (ii) to broaden their cognitive proximity; (iii) to collaborate with others; (iv) to work with technology and data; and (v) to tap into their creative potential.

i. Prepared for a World of Rapid Change

Arbesman insisted that a key goal of these programs should be to generate individuals who can "make sense of the unknown." Imparting this skill is vital because all industries, not only those in technology-related fields, are undergoing rapid change. For instance, in the 1950s, a company could expect to remain on the S&P 500 for about 60 years. Now that number is only 18 years.[21] In the *Black Swan*, Nassim Nicholas Taleb argues that the world has become so intensely informational and statistically complex, that rare, unforeseen events are more pervasive than ever.[22] This all suggests that individuals and companies must be on-guard for the unexpected in order to remain both nimble and relevant. Nies highlighted how he seeks to cultivate these skills by teaching students how "to create an *exploration* mindset rather than an *expert* mindset."

The reality of rapid change is a foundational concept behind Lean, which holds that it no longer makes sense to commit an enormous amount of resources upfront when planning for a new idea. Instead, the time and energy is better spent connecting with customers and testing iterations of the idea. This enables an individual or organization to remain flexible if and when their early assumptions are proven false. Furthermore, a first mover advantage — that is, being the first to bring a new idea to market — is no longer sufficient to remain dominant in an industry. Individuals prepared to enter a world that rapidly changes and are more likely to be able to remake themselves quickly to fit market conditions and thus will be at a competitive advantage.

ii. Cognitive Proximity

As knowledge became more fragmented and specialized over the past two centuries, individuals who can easily understand multiple disciplines became more in-demand. Accordingly, one of the most commonly discussed themes at the Roundtable was the value of cognitive proximity. This concept determines "whether people involved in an interaction can understand, process, and use the information exchanged across industry and intellectual boundaries."[23] The broader an individual's cognitive proximity, the more likely the incidence of successful innovative leaps or "boundary jumping." While this notion appeared as a core feature in many of the programs discussed, it also has one of the highest variances in terminology. The Roundtable noted two common ways to describe an individual with strong cognitive proximity as a "T-Shaped individual" or alternatively a "productive generalist."

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[21] *Lifespans of Top Companies Are Shrinking, According to New Innosight Study of S&P 500 Index*, REUTERS (Feb. 13, 2012, 3:43 PM), http://www.reuters.com/article/2012/02/13/idUS206536+13-Feb-2012+BW20120213.

[22] NASSIM NICHOLAS TALEB, THE BLACK SWAN: THE IMPACT OF THE HIGHLY IMPROBABLE (2010).

[23] *See* Mystery Murphy, *supra* note 5, at 2.

In showing the value of cognitive proximity, Brooks highlighted Miyamoto Musashi, a 16th and 17th century Japanese polymath known by his philosophy and sword-fighting prowess, as an early historical example of a T-Shape. Musashi was renowned for his ability to connect the dots. This skill was aided by his outlook that when you "know one thing, you can apply it to ten." Brooks oversees teams that attempt to solve life and death problems pertaining to toxicology and the spread of diseases. In order to be successful in these non-repeatable situations, he focuses on building teams of T-Shapes who can quickly communicate across disciplines, underscoring the practical application of training individuals with strong cognitive proximity.

In a similar vein, Arbesman described individuals with strong cognitive proximity as "productive generalists." These individuals go beyond random accumulations of knowledge and possess a pattern-making mind, allowing them to see commonalities across disciplines. This ability enables the individual to replicate successful solutions across disciplines without "reinventing the wheel." He pointed out that some specialized fields, such as journalism or the study of complex systems, do a good job of training these characteristics, however, most other fields continue to incentivize specialization. In addition to T-Shapes, Design Centered Thinking seeks to expose students to situations where they will be required to communicate with individuals across varying disciplines in order to solve problems.

Recently, a group of Harvard engineering students demonstrated the value of cognitive proximity when they developed a novel barbecue smoker.[24] Despite a dearth of cooking expertise among team members, they were able to create a prototype that garnered interest from the upscale cookware supplier Williams-Sonoma. The product was revered for its efficiency, quality, and low cost. However, having an engineering base alone likely would not have led the students to create such a highly touted product. To better strengthen the students' cognitive proximity, the course required them to take culinary lessons and learn business fundamentals. Additionally, their guest speakers included a taste chemist, barbecue pit master, and patent specialists. All of this exposure enabled them to take their engineering knowledge and apply it to a different world to solve a problem. This shows that in a world where knowledge specialization has become the norm, regardless of what they are called, individuals who can solve problems across various disciplines is a commonly desired skillset sought to be produced by many of the programs discussed at the Roundtable.

iii. Ready to Collaborate

As the world becomes more interconnected with common applications such as Skype, Slack, and SalesForce facilitate day-to-day corporate processes, more demand is created for individuals who can collaborate with others. Not only does executing any large idea require the input of many individuals, but collaboration in general has been shown to lead to more impactful results.[25] It is no wonder that the "lone genius inventor" has been debunked as more myth than fact in recent years.[26]

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[24] Claire Martin, *Learning to Engineer a Better Brisket*, N.Y. TIMES, July 19, 2015, at BU13, *available at* http://www.nytimes.com/2015/07/19/business/learning-to-engineer-a-better-brisket.html.

[25] ARBESMAN, THE HALF-LIFE OF FACTS, *supra* note 2, at 16 (researchers working in teams are more likely to produce high-impact results than those working alone).

[26] *See* Ben Waber, *the Myth of the Lone Genius*, BLOOMBERG BUS., (Apr. 10, 2014), http://www.bloomberg.com/bw/articles/2014-04-10/the-myth-of-the-lone-genius; Eric D. Isaacs, *Forget About the Mythical Lone Inventor in the Garage*, SLATE (May 18, 2012, 7:00 AM),

With these factors in mind, the Roundtable discussed various nuances related to the need to collaborate.

First, as collaboration becomes more important, there must be a greater emphasis on self-awareness, the personality types of others, and a keener attentiveness to team structures. Brooks observed that, "T-Shapes do best around other T-Shapes," but this then prompts the thought that in order to best utilize a T-Shape, one must know who else fits into this category. Further emphasizing the impact of self-awareness, Sangeeta Bharadwaj-Badal explained her research. Bharadwaj-Badal found that business students in an entrepreneurship course who were given insight into their personality-type responded with a higher degree of confidence in undertaking entrepreneurial roles.

Second, not only is collaborating seen as a vitally important skill to develop, but the Roundtable noted a growing need to have exposure working with others from different disciplines. Barry demonstrated the value of this with an anecdote about a Design Centered Thinking project where both a randomly compiled interdisciplinary team and a team solely comprised of finance majors were given a real-world problem for a financial client. When each team presented to the client, the team of finance majors provided a solution that the client had already considered. The interdisciplinary team was forced to build their solution from the ground up and consider non-traditional solutions and as a result, their solutions "blew the client away" and were better received.

Finally, another notable trend identified by the Roundtable was how millennials perceive the need to collaborate. Rachael Donaldson of Zayo noticed that millennials within the corporate realm seek to switch roles quickly to not only work on different types of projects but to work with different types of individuals. She noted that this should not be seen as a negative, but that some larger corporations have been slow to embrace this attitude. Brooks reinforced this point by suggesting that millennials "already come T-Shaped and pre-wired to collaborate." Based on these observations, an educational curriculum that creates a collaborative environment would also seem to better motivate and stimulate students, while honing these skillsets.

iv. Working with Technology and Data

Now more than ever, it is increasingly important that an individual enters the job market with an ability to use the latest technology tools. Being skilled with technology not only allows an individual the ability to increase their productivity, but it also instills confidence when engaging new innovative tools as they become available. It might be a mistaken stereotype that past generations are afraid of technology, but there is little doubt that future generations are introduced to technology earlier due to the wired environment in which they grew up. For evidence of this, one need look no further than the frequency of young children using iPads and smart-phones.

Underlying many of the newest breakthroughs in technology is the expansive use of data and predictive analytics to automate certain functions. Visible recent mainstream examples of this can be seen in artificial intelligence tools such as Apple's Siri and Google's driverless car. As these tools become more common, a higher value is placed on individuals who are comfortable enough with the newest technologies to use them to help unlock meaningful solutions to problems.

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http://www.slate.com/articles/technology/future_tense/2012/05/argonne_national_lab_director_on_the_myth_of_the_lone_inventor_in_the_garage.html.

Exposure to technology goes beyond simply using the latest gadgets. A few participants found that being skilled at using data to inform thinking was a desired trait. Tom Fischaber of WootMath pointed out that teaching computational thinking, even outside the context of computer science, is valuable in connecting mathematics to real-world applications. Similarly, the use of data to inform human judgments is one of the core goals of Professor Helen Norton's Professional Judgment, Decision-Making, and Problem Solving course at CU Law School, which draws from various scientific disciplines to enhance the tools that law students can utilize when reaching critical conclusions once in practice. This class is uncharacteristic of what would be traditionally found in a law school, but as lawyers enter the modern economy, they are routinely faced with different problems than in years past. Helping them cultivate a skillset that enables them to consider less traditional and even non-legal solutions performs a critical service for students. Even though students are now more than ever entering higher education with a stronger base of working with both technology and data, giving them more exposure to each to further refine these skillsets remains important.

v. Creativity

A few participants brought up the necessity of allowing students the freedom to tap into their creative side while learning core technical competencies. Thomas Edison summed up the importance of creativity in the innovation process by remarking that all you need "to invent is an imagination and a pile of junk." This is especially critical as many common tasks will become automated at a steep rate.[27] R. Keith Sawyer, professor at Washington University in St. Louis, studies approaches to cultivating creativity. He notes the swelling need for creativity in our modern world due to globalization, shorter product development cycles, and more leisure time for citizens in advanced nations.[28] Despite this, his research suggests that creativity remains stifled, with the exception of traditional artistic courses,[29] within higher education classrooms.

Hoping to counter this trend, some of the emergent educational programs such as Design Centered Thinking and Lean Methodologies require students to harness their creative potential to solve problems. By providing students opportunities to think outside the box, they can potentially unlock different solutions to these problems that might otherwise escape them if they were using a more linear mindset.

B. Attitudes to be Cultivated

To better meet the challenges of the modern economy, CU Law School Dean Phil Weiser noted that a certain amount of reorientation of attitudes will be needed. These complement traditional technical skills as well as those noted above in programs aiming to teach innovation. Commonly valued attitudes discussed during the Roundtable include empathy, embracing a network perspective over a hierarchical one, a bias towards doing, building a growth mindset, and identifying new motivations for action.

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[27] News Release, Oxford Martin School, Oxford Martin School Study Shows Nearly Half of US Jobs Could be at Risk of Computerisation, (Sept. 18, 2013), *available at* http://www.futuretech.ox.ac.uk/news-release-oxford-martin-school-study-shows-nearly-half-us-jobs-could-be-risk-computerisation; Jason Ankeny, Meet Amelia, the AI Platform That Could Change the Future of IT, ENTREPRENEUR, June 2015, *available at* http://www.entrepreneur.com/article/245827.

[28] R. KEITH SAWYER, EXPLAINING CREATIVITY: THE SCIENCE OF HUMAN INNOVATION 3 (2012).

[29] *Id.* at 389.

i. Empathy

When seeking to innovate, understanding your customer, her problem, and her unmet needs are vitally important to creating a novel and valuable solution. One of the core features of nearly all programs discussed is instilling the value of empathizing with others regardless of where they are in the hierarchical channels. Empathy is defined as the ability to "understand or share the feelings of another." Nies pointed out that this is the first thing that he teaches his students in order to better allow them to effectively frame problems. Quoting Albert Einstein, he continued that once the problem is effectively framed, the solution will simply "fall out." This mindset seems to flip traditional pedagogy on its head, where more of a focus is placed on a closed set problem that has one answer, which is not necessarily ideal for a student in a more entrepreneurial situation.

A prominent principle of Design Centered Thinking is to train students in the ability to observe others closely in order to better develop empathy. Doing this leads to different conclusions, recommendations, and solutions that may have otherwise been missed due to inherent personal biases. Barry gave an example of the "deep empathy dive" she required one of her classes to perform when evaluating how to optimize bus ridership programs. After spending a day alongside two sets of parents within the core demographic, the students discovered each set of parents valued aspects in their daily commute that defied the students' initial assumptions, highlighting the need to train students to be able to put themselves in other "people's shoes."

Donaldson noted that while "soft skills" such as empathy are critical in a globalized world, they are often devalued when compared to technical skills. In fact, given this paradox, some have urged rebranding these skills as "strong skills."[30] With the rising awareness of emotional intelligence or "EQ" over the past 20 years,[31] this trend is shifting and likely to continue. Regardless, all programs in innovation seem to be ahead of the curve and see the value in training students in mindsets such as empathy.

ii. Network (over Hierarchy)

In Brad Feld's *Startup Communities*, one of the recurring themes is "the massive shift from the hierarchical society that has dominated the industrial era to a networked society that has been emergent throughout the information era."[32] Certainly hierarchies continue to exist functionally, but the importance of a strong network has grown tremendously. This phenomenon has accelerated due to the prevalence of social networks and email. While sometimes obscured by technological innovations, interacting with other human beings remains relevant. As Reid Hoffman puts it in *the Start Up of You*, regardless of the role one finds herself in, "every job boils down to interacting with people. . . . People develop the technologies, write the mission statements, and stand behind the corporate logos . . . [and they] are the source of key resources, opportunities, information, and the

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[30] Jane Miller, *Goodbye to Soft Skills; Hello to Strong Skills*, JANE KNOWS (June 8, 2015), http://janeknows.com/blog/strong-skills.

[31] *See Emotional Intelligence Movement Comes of Age: Six Seconds Says Companies That Leverage "EQ" Training Save Money, Gain a Happier, More Productive Workforce,* BUS. WIRE (Apr. 23, 2013, 12:00 PM), http://www.businesswire.com/news/home/20130423005674/en/Emotional-Intelligence-Movement-Age-Seconds-Companies-Leverage.

[32] Brad Feld, Startup Communities: Building an Entrepreneurial Ecosystem in Your City (2012).

like."[33] Accordingly, those with a strong network can leverage it into a competitive advantage in a variety of areas.

While most of the programs discussed at the Roundtable value this paradigm, it is perhaps most clearly seen with programs that attempt to teach an entrepreneurial mindset. As Brad Bernthal, associate professor at CU Law School, described having a network-based perspective as "crucial in a world where an individual is likely to move across multiple organizations during a career." He elaborated on the importance of teaching students "how to see themselves as actors in a network, more than cogs in a bureaucracy," to better understand "how to create a network, how information spillovers work, and how to provide value to others."[34]

By cultivating an attitude that understands the importance of a strong professional network, those entering the job market will be better equipped to tap into a surprisingly vivid set of resources outside the traditional organizational structure and find out about new information and opportunities much more seamlessly.

iii. Bias Towards Getting Things Done

An attitude growing in prominence within programs of innovation is a bias towards "getting things done." One of the ways to impart this mentality is to afford students the opportunity to build something real within the academic environment. This can take many forms depending on the particular program, for instance, a mechanical engineering course may require a student to build something physical, whereas a course in entrepreneurship may allow the student an opportunity to build a business idea. Regardless of what is created, the residual benefits of such projects can be enormous. This not only allows students to reflect on a successful creation, but it also provides them an example of how one person can make a difference. Moreover, enabling students to create something real removes any would-be academic constraints that may exist within a rhetorical exercise allowing them to sharpen their problem-solving mindset.

Seeking to achieve this goal, various programs place a high emphasis on testing many ideas to rapidly experiment and reach results quickly. This is a fundamental principal of Lean and many courses that use the Lean template require students to "get out of the classroom." Both Lean and an Entrepreneurial Mindset value experiential learning, or doing over planning. Such experiences allow for exposure to focusing on achieving specific objectives, which is especially valuable as real-world projects are increasingly broken down into minute parts to achieve larger goals. This allows them to be better attuned to a job market that increasingly focuses more on outcomes than inputs.

By empowering students to create something real, their confidence should increase as well as their understanding of their role in the larger society becomes clearer. However, to unlock the full potential of this mindset, a student must also be unafraid to fail, which this Report addresses next.

iv. Building a "Growth Mindset"

In *Mindset: the New Psychology of Success*, Carol Dweck posits that we have one of two distinct mindsets which dictate how we live our lives: a fixed mindset, which believes that abilities are set in

[33] HOFFMAN & CASNOCHA, *supra* note 19, at 85.
[34] Bernthal, *supra* note 18.

stone and a purely natural, or a growth mindset, which holds that basic abilities can be cultivated through effort and practice.[35] A growth mindset, which she believes can be refined, affects how an individual views a negative situation and is much better for overcoming adversity. Many Roundtable participants found Dweck's conclusions as important components in teaching innovation. In the context of mathematics, Fischaber pointed out that data strongly suggests "there is no 'math gene,' but that students can make it through to a higher level of math with hard work and practice." This is inconsistent with a fixed mindset, but is completely in line with Dweck's theory.

A few other Roundtable participants shared similar but differently labelled ideas. Reflecting on her own career, Lucy Sanders, the CEO of the National Center for Women & Information Technology, summed up the importance of "the value of the struggle" by noting that she "learned the most by doing things [she] didn't want to do." Andrew MacFarlane echoed this sentiment by specifying the importance of future innovators being "unafraid to fail." Providing students a secure environment where they are allowed to fail and struggle will help cultivate similar attitudes. Within this environment, it is vital to provide encouragement along the way to help produce a growth mindset in students.

In most settings—even beyond higher education—failure and struggle often carry negative connotations, so this attitude might be one of the more difficult ones to cultivate. However, a good starting point may simply be to alter one's ability to view certain situations. In working to arm students with this mindset, Heilbronner places emphasis on teaching optimism. Similarly, Nies aims to teach students the distinction between shame and guilt. Shame reflects on the person, whereas guilt reflects on the action. He clarified that when one responds to a negative result on a problem with shame, it usually results in a halting effect on the student, who takes the result personally. A guilt response to the same situation more properly focuses the student to re-examine what could have been done differently when attacking the problem. In both cases, these attitudes should aid the student in building up grit and the ability to forge on in difficult situations. While the "growth mindset" label may have become in vogue recently, the desired traits identified by it have been valued for generations.

v. New Motivations for Students

When considering alternative educational methods, it is worthwhile to reexamine the traditional motivations of students within higher education. Grade-point average ("GPA") and obtaining a degree remain the strongest incentives for students. While these signifiers are still very important, they provide only part of the insight needed to evaluate an individual. As the market becomes more saturated with college educated individuals, additional characteristics are being utilized to define a quality employee more holistically. This shift has been embraced more firmly by some. As a somewhat extreme example of this backlash, Laszlo Bock, a senior vice president at Google pointed out that when hiring, he views GPAs as "worthless criteria" for determining the long-term success of the company's managers.[36] This has even led the company to stop asking for transcripts from applicants. While Bock's quote might be overstated for effect, it does highlight an important trend and a move by some towards competency based education, which favors the end result skillset regardless of the impact on one's GPA.

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[35] CAROL DWECK, MINDSET: THE NEW PSYCHOLOGY OF SUCCESS (2006).

[36] Adam Bryant, *In Head-Hunting, Big Data May Not Be Such a Big Deal*, N.Y. TIMES, June 20, 2013, at F6, *available at* http://www.nytimes.com/2013/06/20/business/in-head-hunting-big-data-may-not-be-such-a-big-deal.html.

Tapping into students' ulterior motivations has always been a challenge for educators. The problem with cultivating different motivators is that most students have been trained since a very young age that grades are the pinnacle of success within education. Ironically, this leads many students to seek the best grade at the lowest cost by taking short-cuts where it will not directly impact their grade, regardless of any trade-offs along the way. Some may think this is a devious, but the traditional system actually incentivizes this behavior.

Some students can generate intrinsic motivation in order to expand what they receive from their education, but for others, various methods will be required to help assist with this attitude shift. For instance, Nies seeks to do this by showing students that "the journey is just as important as the end result." Barry's educational programs similarly seek to better "slow down the problem-solving process" so the student can gain a broader perspective on the value of the process.

Whatever form these new motivations take, they will not supplant grade-based models of evaluation, but rather help students get the more out of their education. Furthermore, they also enable a student to be better prepared for a real-world environment where a "winner-take-all" outcome and firm objective standards are less common.

III. Pedagogy and Teaching Methods: How the Objectives Are Being Achieved

While the Roundtable discussion surrounding desired outcomes gave tremendous insight into the goals of the programs training innovation, some of the most interesting information-sharing occurred when participants discussed various methods they have found successful in cultivating the skills and attitudes outlined above. Innovation may seem to be an amorphous concept that defies easy definition. But this does not preclude the ability to teach it. As Nies observed, innovation is "part art, and part science" that can be taught. Below are some of the methods that educators are employing to teach innovation.

i. Individualized Experiences

One of the most discussed methods when training innovation is individualizing the learning experience for students. From a cost-benefit perspective, a one-size-fits-all approach to deploying knowledge might make sense, but the trade-off is that some individuals can get lost in the shuffle and forced into situations where their learning environment is not optimal. As participant Bharadwaj-Badal pointed out, certain pedagogical methods will not work for some students. This caused participants to discuss perceived benefits of crafting teaching methods based on various characteristics of both the student and the educator.

Many participants noted that a key factor for individualizing a student's learning experience requires self-awareness on the part of the student, but perhaps just as important is the teacher possessing awareness of differentiated learning styles. Bharadwaj-Badal pointed out that incoming students who know their inherent strengths can be coached around these characteristics, but it also requires that teachers understand how to "coach to these factors" to achieve a successful personalized educational experience. Jennifer Cunningham of AskWhyFilms also pointed out that if self-awareness is taught to students earlier in their educational careers, it will be a more natural transition once they reach higher education. Barry supported this statement by referring to a recent

study she performed with local 6th graders who understood that to be successful, they need to go to college and get good grades, but beyond that, most did not fully comprehend why these things were important nor how to achieve them, suggesting a lack of understanding of how self-awareness contributed to such goals.

Another benefit of an individualized educational experience that the Roundtable noted was that self-chosen educational paths usually will maximize motivation. This essentially empowers the student by virtue of him having more autonomy in selecting where his or her best efforts are directed. Binford suggested a method for doing this by not only asking students "what do you think," which is a traditional goal of higher education, but also asking them the "why" behind any answer to the first question. This makes students responsible for their own education as the educational journey is now more interactive, and more of a two-way system as opposed to a traditional "hierarchical, top-down content delivery from the [teaching] authority to the student," as Binford described it.

ii. Better Alignment of Motivations with Desired Outcomes

As outlined above, for a student to receive the most out of a modern education, she must strive to locate motivating factors beyond the traditional GPA. While vital for students to generate additional motivations for this, educators should also play a role in this shift. The most seamless way is a better alignment of incentives with the desired outcomes.

One method Nies uses is to "grade on the journey, the process and the struggles" instead of the end result. Similarly, Binford requires a course-end portfolio from her students that includes all iterations, sources, and background work that went into the final project. By grading on the more procedural aspects of the deliverables, students are more likely to receive the skills and attitudes that the instructors are seeking to impart.

Cunningham suggested that it is vital to achieve this better alignment with students at an earlier age—even before they enter higher education. She pointed out that since most are trained with certain motivations at a young age—during their formative K-12 education—resulting habits will be difficult to change. Because of this, Cunningham that proposed moving away from traditional GPA and SAT standards of success for students before entering higher education.

iii. Team-based Opportunities

As collaboration becomes increasingly important, experiences where students work in teams are a core tenet of innovation programs. Every program discussed at the Roundtable contained some sort of team-based work, with some featuring it more heavily than others.

Not only is it important to provide opportunities for students to work in teams, but many programs in innovation also include working across disciplines. Traditional higher-level coursework generally features a homogenous group of students within the same discipline or major. Because of this, some educators see the importance of creating realms dedicated to crossing disciplines. CU Boulder has made a concerted effort to institutionalize these situations in a few different settings with three recently created initiatives. Rebecca Komarek, Assistant Director of the IdeaForge, described it as a flexible, cross-disciplinary co-working space open to students from all departments. She explained its core mission of providing an "informal setting where many unnecessary, but

traditional rules in higher education are stripped away to promote boundary jumping with just enough structure to ensure that learning is still occurring." Similarly, the BioFrontiers Institute is a space where students across the traditional sciences, engineering, and computer science can work together to collaborate on projects. Lastly, in order to better develop innovators at the "intersection of technology and society," the ATLAS Institute provides interdisciplinary courses for nearly one-thousand students regardless of their major.

iv. Experiential Learning

Many participants agreed on the high-value of providing experiential opportunities to students in programs aiming to teach innovation. As Nies remarked "I don't believe you can learn the entrepreneurial journey by reading it in a book or talking to other people. . . [It] must be learned by doing." Brooks emphatically agreed with this premise by stating that T-Shapes are forged in an environment where they "learn by doing." Underscoring this phenomenon with a personal anecdote was Kelly Dwyer, who noted at one of her "best experiences from business school was an immersion class which paired teams with real companies all semester long to analyze a problem faced by the each company."

Bill Mooz, scholar-in-residence at CU Law School noted that the biggest gap in the educational system is in applied learning. Clif Harald from the Boulder Economic Council, noted a similar sentiment from an industry point of view by concluding that the even though the market is showing an overwhelming demand students with significant experiential learning, it seems to be in short supply of them.

Barry's anecdote in section II.B.i *supra* from her Design Centered Thinking course about the bus ridership project was a perfect example of how experiential learning can work. Within a law school setting, clinical programs have a similar broadening effect on a student's desire to learn and the ability to get real-world experience while still within the classroom. Similarly, externships or school sponsored internships can help bridge this gap.

In order to provide students with opportunities to garner experiential learning, many of the new programs seeking to train innovative individuals are seeking to bring real-world problems into the classroom for students to solve. Not only does this provide a more vivid learning experience with less artificial constraints but also develops stronger ties between the business community and the classroom.

v. Community as Part of the Classroom

Many of the individual programs discussed at the Roundtable highlight that the community should be seen as an extension of the classroom. This works in two ways. First, community members can be a valuable part of the in-classroom experience. Individuals with experience within a certain field can enhance traditional pedagogical methods and expose students to a wider perspective of that field. This teaching method can also serve to stimulate the learning experience for students. Second, and perhaps more important, students in innovation programs are frequently directly involved in community environments.

Classes in innovation are sometimes co-taught in a "town – gown" configuration, i.e., by combining a full-time professor and an expert practitioner from the community. Such courses can

be highly regarded by students. For instance, at the University of Colorado, Bernthal's Venture Capital: 360 course at the law school is co-taught by Jason Mendelson, a managing director of the Foundry Group, a local venture capital fund. Similarly, Bret Fund co-teaches a venture capital course at the business school with Dan Caruso, the Chief Executive Officer of the Zayo Group. Within the computer science department, Nies's Startup Essentials course is co-taught with Rick Han, a professor of computer science. All of these classes are extremely popular, in large part, due to the fact that they enhance the student's overall ability to grasp the subject.

In general, co-teaching can yield high-quality results at a low cost and is likely the most common method within higher education of connecting students with community members. Beyond this model, different flavors of this concept are also being used. One of these is embedding a course requirement of having students work on projects in the community. For instance, Heilbronner's Philosophy of Entrepreneurship class pairs student teams with local businesses to assist on various projects such as diligence or market research. Similarly, many Design Centered Thinking programs also feature this arrangement. As another variant, Bernthal mentioned the New Venture Challenge, an extra-curricular on-campus entrepreneurship competition supported by the university that connects student teams to mentors within the community with great success. These methods foster better connections between students and the community, thus deepening the educational experience, but also allow for more experiential learning, the value of which was discussed in the previous section.

vi. Ongoing Engagement and Stimulation

Now more than ever it is necessary for students to tap into motivations beyond their GPA to get the most out of their educational experience. Some students will be able to generate with intrinsic motivation on their own, however educators can utilize some methods to help keep students engaged and stimulated. The Roundtable noted a few of these methods are proving successful.

The term "mentor" has become one of those amorphous concepts that has a different meaning across various situations. Part of the reason for this is that many companies tout mentorships programs with have a variety of flavors. In other settings, programs such as the TechStars startup accelerator have done a great job of showcasing the efficacy of the mentoring concept. When it comes to higher education, however, providing students with opportunities to connect with mentors has been somewhat neglected. Research is now showing that having just one strong mentor in a student's life can have an overwhelming impact when it comes to keeping her focused and engaged to take full advantage of her educational journey.[37] This mentor can be a teacher or someone outside the educational system. These individuals can help unlock a student's full potential, with the relationships often lasting beyond a student's higher educational career to remain a positive influence in that student's life. Many of the programs discussed at the Roundtable feature some sort of mentoring component, however this concept should be considered strongly in higher education broadly, as it may be one of the key drivers in keeping universities competitive with massive open online courses ("MOOCs").

[37] Brandon Busteed, *The Real Disruptive Innovation in Education*, GALLUP BUS. J. (Dec. 1, 2014), http://www.gallup.com/businessjournal/179564/real-disruptive-innovation-education.aspx.

Another highly touted method to keep students stimulated is the concept of peer-to-peer learning, where one or many students teaches the rest of a class. Not only does this position students to appreciate the subject material differently by communicating the topic to others, but generally, this method has also been shown to be one of the most effective ways to remember content, further enhancing the student's ability to grasp a certain subject.[38] Multiple Roundtable participants shared positive experiences with this method, which has also been described as "flipped learning."

Providing extensive and on-going feedback is vitally important in all settings, but this is especially true in the context of higher education. Consequently, the Roundtable presented a variety of views on this topic and how it can serve as an indispensable tool to keeping students engaged. While teachers are inherently in the business of providing feedback through grades, Nies pointed out how critical it is to now provide qualitative feedback on a student's work. Bharadwaj-Badal suggested considering feedback from all sources—similar to a 360 feedback evaluation within a corporate setting. Binford provided one example of how this might work in practice by explaining why she utilizes peer feedback, where students have the opportunity to provide feedback for each other. She highlighted this method's dual-purpose effect – being able generate feedback for the recipient while allowing those providing the feedback to be more self-critical of their own work by being able to see what others have done. Bharadwaj-Badal added to this point by explaining that self-evaluation, especially within teams, can be messy but is very informative. Cunningham added that it might be worthwhile to consider including community members in the feedback process.

Finally, authenticity can be a great, latent, intrinsic motivator for students. Barry highlighted this point by discussing one of her Design Centered Thinking programs where students helped a boutique cake-maker in Germany solve real-world problems. She suggested that on its face, the students—who did not receive credit or a grade on the project—may have been apathetic about the work at the beginning, however as the project progressed, they wound up working until 4am, thus demonstrating their commitment to the project. She concluded that the project's authenticity added an additional motivating factor that drove their ability to get more out of the project.

IV. Dodging the Machine

As with most new methods—especially those contrary to 200 years of pedagogical tradition—structural challenges will exist. This section attempts to detail some of the challenges identified by the Roundtable when seeking to implement programs that aim to create flexible and adaptable students. This section is broken into two subsections. The first identifies some of the hurdles within the university structure and second, those within the corporate realm. Within each, solutions proposed by the Roundtable are briefly highlighted.

A. The University Machine

The modern research university structure is the most pervasive in higher education. It began at the dawn of the 19th century in Germany, and since has spread considerably.[39] Because of its long-standing and successful history, making structural changes at odds with it may prove difficult

[38] Warren Binford, *How to Be the World's Best Law Professor*, 64 J. LEG. ED. 542, 552 (2015).
[39] WELLMON, *supra* note 4.

for a variety of reasons. Some of these reasons were identified by Roundtable participants, especially as they pertain to resource constraints, incentives structures, and traditional motivations of students.

i. General Resource Constraints

Making the most of what limited resources are available is something that afflicts the educational system at every level. Erick Mueller, the Director of Student Experience at the Deming Center for Entrepreneurship, was the first to raise the subject. While optimistic about many of the programs discussed, he questioned their potential to scale without sacrificing quality. Mueller's point is critical as universities are receiving less outside funding and are forced to switch priorities to a cost-management system that focuses more on top-down lectures.[40] Even though this dilemma poses great difficulty, a few Roundtable participants proposed some solutions to the resource constraints placed upon educators.

Mooz responded to Mueller's question by drawing on his experience in teaching Technology Transactions at CU Law School. Generally, he proposed pulling the individual components of delivering knowledge apart and to more efficiently apply resources to each constituent part. This would entail scaling certain aspects of the experience—such as lecturing—by leveraging available technology tools. While educators have used collaboration tools such as on-line portals for years, some may not be utilizing these tools to their fullest potential. Beyond simply acting as an on-line assignment drop-box, many aspects of a course can be handled on-line to free up time for the teacher to focus more on giving individual students more specific attention. To this end, Mooz video recorded lectures for his course and requires students to review these in advance of class. This allowed class time to be spent on answering questions and participating in more experiential exercises.

For aspects which require a hands-on approach within the classroom, relying purely on technology may result in a downgrade in teaching quality. Because of this, additional creativity may be required to cull less traditional resources. Mooz gave an example of this in detailing how he brings in practicing lawyers to mentor teams of students during negotiation exercises. Each mentor co-teaches on a volunteer basis and "happily does so for the satisfaction they get in sharing their knowledge with the next generation of professionals." In the end, this model poses no additional costs to the school and ultimately the student, and increases the quality of the educational experience. Indeed, co-teaching, one of the methods explained above in section III.v *supra* is one of the more popular new methods for addressing resource constraints.

Another possible solution is to "end-run" the university entirely, and feature supplemental programs that teach innovation with limited or no association with the university. While some great examples of this such as startup accelerators and MOOCs are having great results, they mostly involve relinquishing the role of teaching to the private sector. In spite of this, the university need not step aside entirely. Through non-credit offerings, universities can still leverage infrastructure to cultivate an environment where innovation can be taught. Bernthal raised an example of this in describing the CU New Venture Challenge, which at its core is an entrepreneurship competition. The NVC offers an exhilarating environment where students can try out a business idea, attend various skill-building workshops and tap into a vast network of local mentors willing to help out for free.

[40] *See supra* Introduction.

ii. The Existing Incentive System for Higher Education Faculty

Another commonly discussed challenge in teaching non-traditional courses within the university structure is the incentive systems for faculty members. This is even more accentuated due to the resource constraints identified in the previous section, but seems less flexible to change due to its structure and tradition. Dr. Tom Cech, investigator at the Howard Hughes Medical Institute who also teaches in the University of Colorado's Chemistry Department, highlighted the financial-side of the incentive structure by pointing out that the system favors teaching 500 students in a lecture versus a four students in a lab setting, regardless of clear disparity between the two in overall quality of learning.

A similar pain-point arises when attempting to teach interdisciplinary courses. Cech expressed frustration when seeking out faculty members from other disciplines to co-teach. He pointed out that the specialization and defensiveness that have been reinforced for centuries tend to make some hesitant to demonstrate leadership and try new things. Those willing to partake in such courses often do so at the expense of an "overload" in addition to their current obligations, which creates a negative incentive. Upon hearing much of the discussion about co-teaching with community members, Cech expressed a desire to seek out such individuals to co-teach rather than courting current university faculty. Overcoming some of these entrenched institutional attitudes will remain a work in progress.

One way to change institutional attitudes is to change the institution itself by making interdisciplinary work and more experiential courses part of the new status quo. Arbesman suggested a something like a "dabbler badge for knowledge" within the university system, which would be akin to minoring in many subjects. He drew inspiration from the Girl Scouts who historically awarded a "dabbler badge" for scouts who were generalists and attempted multiple crafts, as opposed to specializing in one or two.[41] More concretely, some institutional methods that favor interdisciplinary work and less traditional pedagogy are beginning to spawn. Examples of this at the University of Colorado include the IdeaForge, the BioFrontiers institute and the ATLAS institute, detailed in section III.iii *supra*. Beyond these efforts, some are even trying to implement institutional programs that foster innovation and interdisciplinary work through degree accreditation. The University of Colorado – Colorado Springs recently unveiled its Bachelor's of Innovation degree program.[42] Within this, students can major in a traditional subject such as Business Administration or Electrical Engineering, but are given a stronger focus in less traditional learning methods. The degree still requires a majority of credits to be completed in traditional university courses, but also requires students to take interdisciplinary and innovation focused classes. These initiatives are still young, but seem promising.

iii. The "Grade Culture"

The incentive structure for students also poses difficulties for programs seeking create adaptable and flexible individuals. Many of these programs impart intangible skills such as empathy and preparing for a world of rapid change that are difficult to evaluate objectively. The challenge

[41] *See* Diane Gilleland, *Crafty Merit Badges*, CRAFTY POD, (June 27, 2007) http://www.craftypod.com/2007/06/27/crafty-merit-badges.

[42] Terry Boult et. al., Innovations in University Education in Innovation: Moving Beyond the B.S. (2009) (unpublished manuscript) (on file with author).

here is properly motivating students to value these skills even if their grade will not accurately reflect their effort towards these goals. This creates motivational challenges, not just over the entirety of their higher education careers, but also over the span of semesters. Mueller noted that keeping students motivated for 4 months without costing an inordinate amount of money is already difficult. As a semester wears on, a student motivated solely by grades might be apt to take the path of least resistance to maximize grades, instead of seeking out a more potentially rewarding outcome. This mindset persists, because, as Bharadwaj-Badal explained "students are trained to be graded."

Retraining a student to have a different mindset is a strong way to overcome this challenge. This might be most effective by tapping into a student's intrinsic motivations as early as possible. Binford pointed out that pre-assessments have already been implemented in schools of management and education with great success. These assessments "focus on identifying gaps in knowledge so that students who need remediation can receive it, and those who do not can move ahead in their studies." Also, they can "help students to identify a course's priorities to be more realistic about their own gaps in knowledge so that they can prioritize more appropriately." Binford added that with all of the data available to educators, using technology to better customize the learning environment should be greatly enhanced.

The need for this type of evaluation or screening is more apparent than ever. As Mooz noted, too many students "default into college" and need better guidance as they make the transition. In some cases, entering college after high school might not be the best fit or right timing for a certain individual. Such a pre-college assessment could include better admissions criteria determining not only if an individual is qualified to get into college, but if it is currently the best option for them. Along these lines, Stanford has already begun to experiment with the "open-loop university" concept, where "returning students would loop back into Stanford for a mid-career refresh, while younger students might take a loop outside of Stanford to test what they are learning in an external environment."[43] This flexibility would remove many of the traditional pressures and attitudes that may inhibit a student seeking to chart their own educational path.

While pre-assessments would greatly help tap into the student's natural tendencies and motivations to maximize the learning experience, Bharadwaj-Badal cautioned that such assessments should not be one-time ordeals. Since many college students undergo massive personality changes during this time in their life, she lauded the use of a constant feedback loop as being essential to "ensure they will be the best professional they can be" within the university system.

B. The Corporate Machine

Even though the Roundtable focused mostly on challenges within higher education, naturally the discussion included some of the difficulties in the corporate setting as well. Generally, these challenges were structural, but the Roundtable identified a few specific aspects that warranted closer discussion such as hiring practices and confusion of terminology and concepts.

Carl Patten, of Centura Health, succinctly noted that "organizations tend to be bipolar" when it comes to enacting change—with bigger ones being more afflicted in this regard. Like the children's game of "Telephone," the top of the organization may express a commitment to certain

[43] Brad Hayward, *Exploring Provocative Ideas for undergraduate Education at Stanford*, STANFORD REP. (May 5, 2014), http://news.stanford.edu/news/2014/may/dschool-undergrad-reimagined-050514.html.

changes, but by the time the tweaks are effectuated near the bottom, "things get weird," as Patten put it. Within this structure, it may be difficult for entrepreneurial-minded efforts to get off the ground.

Brooks offered a similar point of view regarding T-Shapes, warning that they will "suffocate" if not given systemic support by the organization. They need to be surrounded by other T-Shapes and "given appetizing projects" in order to flourish. Brooks suggests that a successful system must be "self-replicating and self-nurturing. . . with an emphasis on preserving" the T-Shapes that already exist.

One major structural challenge in the corporate realm occurs during the entrance into the machine—the hiring process. Sanders made the case that this is a pervasive issue because job descriptions rarely reflect the skills that employers desire, and instead usually contain extremely lofty and unrealistic expectations. Further, while job descriptions always list concrete job skills, companies have a difficult time figuring out how to evaluate some of the softer skills such as an individual's ability to collaborate or their overall desirability to grow. Dwyer added a tangible example by suggesting that while a "productive generalist" might be desired by an employer, if recruiter does not understand the concept, finding such an individual fit becomes a haphazard endeavor.

A difficulty that underlies the challenges posed by organizational commitment and hiring inefficiencies stems from confusion of terms and concepts surrounding these programs. Sanders pointed out that "the problem might be more about how we talk about things and the vocabulary used." Sustaining the discussion and "open sourcing" information, as proposed by Cook, can only help clear up some of this confusion. Additionally, works such as this Report hope to provide additional clarity to overcome this challenge.

Simply put, for many of these new skills and attitudes to subsist, a structural commitment to understand and value them must be present. Nies noted that changing the environment is vital to overcoming attitudes resistant to the many of these concepts. Showing that this is possible in practice, he told of a story of a "walled off" engineer at a large tech company who initially was very resistant to the concepts Nies taught. By the end of the experience, this individual was a "collaboration leader" and completely bought into the new methods. While these stories are helpful, institutional culture is difficult to change, and a key component of producing the structural commitment required will take time and a continued educational effort.

Conclusion

Due to modern changes in the economy, educators are seeking the best ways to inculcate students with principals that will enable the next generation of great innovators. The movement to teach these new skills has resulted in various programs within higher education taking many different forms and shapes. Even though many of these programs are considered experimental at this point, given their emergence, they warrant closer examination to document trends. Across these programs, some of commonalities are easily seen. In other cases, additional discussion is required to reveal the similarities. This Report hopes to capture both the latent and apparent similarities in some

of the popular programs aiming to teach innovators. For these programs to thrive, information needs to be shared so others can utilize successful methods.

Appendix A
Roundtable Participants

Sam Arbesman, Senior Adjunct Fellow, Silicon Flatirons Center for Law, Technology and Entrepreneurship
Co Barry, Founder & Head of Professional Development, CreatEdu
Brad Bernthal, Associate Professor, University of Colorado Law School
Dr. Sangeeta Bharadwaj-Badal, Senior Consultant & Lead Scientist, Gallup
Warren Binford, Associate Professor of Law & Director, Clinical Law Programs, Willamette University College of Law
Dr. Bradford Brooks, Director, Corporate Toxicology & Chemical Management, IBM
Dr. Tom Cech, Investigator, Howard Hughes Medical Institute
Libby Cook, Founder, President & Director, Philanthropiece
Jennifer Cunningham, Founder, Ask Why Films
Rachael Donaldson, Vice President, People Culture Brand, Zayo Group
Kelly Dwyer, International Expansion Consultant, Ishwari LLC
Andy Evans, Entrepreneurial Fellow, Silicon Flatirons Center for Law, Technology and Entrepreneurship
Anna Ewing, Executive Director, Colorado Innovation Network
Tom Fischaber, Vice President of Operations & Co-Founder, WootMath
Don Grant, Professor & Department Chair, University of Colorado Department of Sociology
Clif Harald, Executive Director, Boulder Economic Council
Sue Heilbronner, Chief Executive Officer & Co-Founder, MergeLane
Rebecca Komarek, Assistant Director, Idea Forge
Andrew MacFarlane, Chief Executive Officer & Co-Founder, Mobile Pulse
Andy Marchant, Incoming Entrepreneurial Fellow, Silicon Flatirons Center for Law, Technology and Entrepreneurship
Bill Mooz, Strategy Officer & Scholar in Residence, University of Colorado Law School
Erick Mueller, Director of Student Experience, University of Colorado Deming Center for Entrepreneurship
Zach Nies, Managing Director, TechStars Boulder
Helen Norton, Associate Professor of Law, University of Colorado Law School
Carl Patten, Director, Medical-Legal Partnerships, Centura Health
Allyson Patterson, Director of Community Relations, Zayo Group
Blake Reid, Assistant Clinical Professor, University of Colorado Law School
Lucy Sanders, Chief Executive Officer & Co-Founder, National Center for Women & Information Technology
Phil Weiser, Dean, University of Colorado Law School

Appendix B
Roundtable Suggested Reading List

1. Sam Arbesman, *Let's Bring the Polymath—and the Dabblers—Back*, WIRED (Dec. 13, 2013, 9:30 AM), *available at* http://www.wired.com/2013/12/165191.
2. Brad Bernthal, *Colleges Must Mix Entrepreneurial Skills, Traditional Liberal Arts*, XCONOMY (Jan. 14, 2015), http://www.xconomy.com/boulder-denver/2015/01/14/colleges-must-mix-entrepreneurial-skills-traditional-liberal-arts.
3. Warren Binford, *How to Be the World's Best Law Professor*, 64 J. LEG. ED. 542 (2015).
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8. Brad Feld, *Recreating Law School*, FELD THOUGHTS (Oct. 3, 2013), http://www.feld.com/archives/2013/10/recreating-law-school.html
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13. MYSTERY MURPHY, SILICON FLATIRONS CTR., BOUNDARY JUMPING: UNDERSTANDING THE VALUE OF MODEST ANARCHY IN ENTREPRENEURIAL NETWORKS (2014), *available at* http://www.silicon-flatirons.org/documents/publications/report/201401BoundaryJumpingReport.pdf.
14. *Succeeding Through Service Innovation: A Service Perspective for Education, Research, Business and Government*, UNIV. CAMBRIDGE (2008), *available at* http://www.ssmenetuk.org/docs/cambridge_ssme_symposium_discussion_paper_final.pdf.
15. *T-Shaped People, Jobs, and Recruiting*, FIX CURRICULUM VITAE, *available at* http://fixcv.com/t-shaped-people-jobs-andrecruiting-4828.html.
16. T Summit 2015 information, *available at* http://tsummit2014.org/t.