

A Comparison of Maker and Entrepreneurial Characteristics

Miles J, Mabey, Arizona State University

Miles Mabey (Yes that's his real last name) is a third year student at Arizona State University studying Robotic Engineering. He joined the Maker Research team two years ago and has been to the Bay Area and New York Maker Faires.

Dr. Shawn S. Jordan, Arizona State University, Polytechnic campus

SHAWN JORDAN, Ph.D. is an Assistant Professor of engineering in the Ira A. Fulton Schools of Engineering at Arizona State University. He teaches context-centered electrical engineering and embedded systems design courses, and studies the use of context in both K-12 and undergraduate engineering design education. He received his Ph.D. in Engineering Education (2010) and M.S./B.S. in Electrical and Computer Engineering from Purdue University. Dr. Jordan is PI on several NSF-funded projects related to design, including an NSF Early CAREER Award entitled "CAREER: Engineering Design Across Navajo Culture, Community, and Society" and "Might Young Makers be the Engineers of the Future?," and is a Co-PI on the NSF Revolutionizing Engineering Departments grant "Additive Innovation: An Educational Ecosystem of Making and Risk Taking." He was named one of ASEE PRISM's "20 Faculty Under 40" in 2014, and received a Presidential Early Career Award for Scientists and Engineers from President Obama in 2017.

Dr. Jordan co-developed the STEAM Labs™ program to engage middle and high school students in learning science, technology, engineering, arts, and math concepts through designing and building chain reaction machines. He founded and led teams to two collegiate Rube Goldberg Machine Contest national championships, and has appeared on many TV shows (including Modern Marvels on The History Channel and Jimmy Kimmel Live on ABC) and a movie with his chain reaction machines. He serves on the Board of the i.d.e.a. Museum in Mesa, AZ, and worked as a behind-the-scenes engineer for season 3 of the PBS engineering design reality TV show Design Squad. He also held the Guinness World Record for the largest number of steps – 125 – in a working Rube Goldberg machine.

Dr. Micah Lande, Arizona State University

Micah Lande, Ph.D. is an Assistant Professor in the Engineering and Manufacturing Engineering programs and Tooker Professor at the Polytechnic School in the Ira A. Fulton Schools of Engineering at Arizona State University. He teaches human-centered engineering design, design thinking, and design innovation project courses. Dr. Lande researches how technical and non-technical people learn and apply a design process to their work. He is interested in the intersection of designerly epistemic identities and vocational pathways. Dr. Lande is the PI/co-PI on NSF-funded projects focused on engineering doing and making, citizen science and engineering outreach, and "revolutionizing" engineering education. He has also been an instructor and participant in the NSF Innovation Corps for Learning program. He received his B.S in Engineering (Product Design), M.A. in Education (Learning, Design and Technology) and Ph.D. in Mechanical Engineering (Design Education) from Stanford University.

Steven Weiner, Arizona State University, Polytechnic campus

Steven Weiner is a PhD student in Human and Social Dimensions of Science and Technology at the School for the Future of Innovation in Society at Arizona State University. He is interested in researching innovative learning frameworks at the intersection of formal and informal STEM education, specifically focusing on the impact of long-term, project-based programs on middle and high school students at community makerspaces and science centers. Before starting his doctoral studies, Mr. Weiner served as the founding Program Director for CREATE at Arizona Science Center, a hybrid educational makerspace/community learning center. He has previous experience as a physics and math instructor at the middle school and high school levels.

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Introduction

At Maker Faires around the world, self-proclaimed Makers embody attitudes and characteristics of entrepreneurs as demonstrated by their commitment to innovation. Makers are self-defined do-it-yourself inventors who participate in an active socio-technical community of sharing [21]. One common gathering for the community of innovators are Maker Faires, which are large festivals that celebrate creativity, passion for building, and commitment to informal education [19]. The tagline of the Maker Faire is “The greatest show and tell on earth” [8]. Makers from all across the globe travel to display their projects and/or to look at other Maker’s projects, some even end up collaborating on random projects [16]. Maker Faires have become more popular in the last decade, with over 130,000 people attending the flagship Bay Area Maker Faire and over 85,000 attending the World Maker Faire in New York in 2016 [14].

One example of an entrepreneurial Maker project is the PancakeBot, which is a 3D printer for pancake batter (<http://www.pancakebot.com/>). This invention was initially prototyped with Lego® bricks and displayed at the World Maker Faire in New York in 2012. The interest in the product from Makers was so great that the inventors decided to put the project on Kickstarter, where they raised \$460,584 in a month. This Maker-entrepreneur success story will be discussed further in this paper.

Literature Review

Entrepreneurs can be defined many ways but colloquially are known as people who start an enterprise with considerable initiative and risk [9]. They have a diverse set of skills including teamwork, public speaking, and networking. In this paper, the KEEN [2] and Five Roles [3] frameworks are used for defining exactly what an entrepreneur does and what characteristics they have. While many Makers are entrepreneurial and many Entrepreneurs make things, there is a surprising lack of research on the intersection between these two schools of thought. This study seeks to elucidate the intersection between Making and entrepreneurship.

Entrepreneurs as well as Makers are seeing a growth in opportunities as technology evolves. These opportunities are often the same for both communities and overlap is generated. The expansion and widespread use of technology like the Internet and 3-D printing presents new opportunities for entrepreneurs [4]. Some universities offer entrepreneurship degrees and there has been a push to expose engineering students to entrepreneurial mindsets [2]. At this same time, the Maker Movement has been gaining momentum. This growth in both communities has inspired researchers to study Makers who are also Entrepreneurs. An example of this is in Shenzhen, China where innovative technology crosses with Making, Maker Entrepreneurs are fostered [5].

The KEEN [2] and the Five Roles [3] entrepreneurship frameworks provide useful characteristics to better understand Maker-Entrepreneurs. For example, many Entrepreneurs and Makers are driven by their passions or their desire to make something that did not exist before. There has been an increase in startups and other entrepreneurial activities, especially in colleges [2]. Today, technology enables these mindsets to make an impact on their environment. Sites such as Kickstarter and Indiegogo allow entrepreneurs to connect directly with their target markets. Technology also allows organizations like KEEN [2] to educate society on the value of entrepreneurship and opportunities to become an entrepreneur.

The Kern Entrepreneurship Education Network (KEEN) defines entrepreneurship as “self-employment through business ownership, which has significant elements of risk, control and reward” [2]. The KEEN framework is best described with a pyramid (see Figure 1) that describes

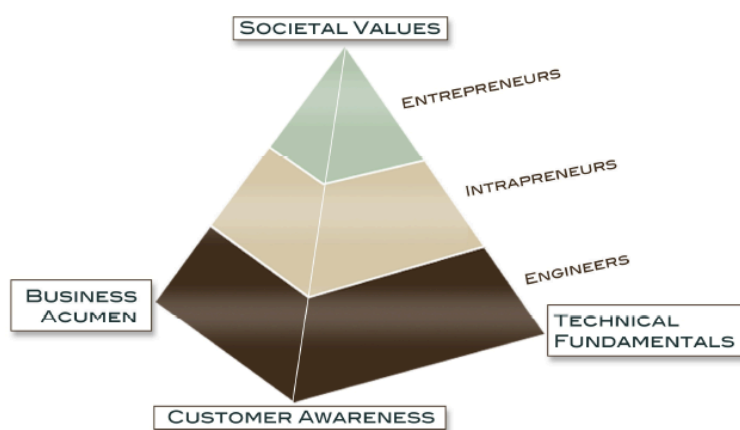


Figure 1: KEEN Pyramid [2]

key characteristics of entrepreneurially-minded engineers. The four corners making up this pyramid are Societal Values, Business Acumen, Technical Fundamentals, and Customer Awareness. The KEEN organization seeks to spread the entrepreneurial mindset into many fields, including engineering.

While the KEEN framework defines what

entrepreneurs should do, the Five Roles framework is created from what entrepreneurs report doing in the Global Leadership and Organizational Behaviors Effectiveness (GLOBE) survey [3]. The GLOBE survey is part of “a multi-method project in which investigators spanning the world are examining the interrelationships between societal culture, organizational culture, and organizational leadership. Close to 150 social scientists and management scholars from 61 cultures representing all major regions of the world are engaged in this long-term programmatic series of cross-cultural studies” [7]. Analysis of responses to the GLOBE survey found 19 leadership attributes relevant to entrepreneurship, which were sorted into five major themes. The five roles are framing the challenge, absorbing uncertainty, path clearing, building commitment, and specifying limits. This framework focuses on the attributes an entrepreneur has, which is used to define what an entrepreneur is.

Research Question

The primary research question guiding this work is:

RQ: How can Maker behaviors be understood through an entrepreneurial mindset lens?

These research questions are derived from a larger study on makers and their motivations, knowledge and thought processes. This paper analyzes the interviews from the lens of entrepreneurial mindsets.

Theoretical Frameworks

Two primary frameworks were used for this study: the KEEN [2] and Five Roles [3] frameworks. The KEEN [2] framework is based on skills an entrepreneur should have and activities they should be able to do. It was selected because KEEN has an interesting in who else can be considered entrepreneurial and it offers a general perspective on what activities fit into this category. Table 1 shows an excerpt from the KEEN [2] framework on societal values is shown. The full framework is shown in Appendix 1.

Table 1: KEEN Framework [2]

Research Emphasis	Definition
Value free enterprise	Shows this in their attitudes towards rules and regulations
Supporting personal freedom and liberty	Demonstrated attitudes or workplace policies that support personal liberty. Listening to individuals
Serve the needs of others	Project or startup is made to solve other people's problems
Internal customers (i.e. through teamwork)	Showing support for other team members
External customers (i.e. domestic and international customers)	Having good customer support and putting effort into making customers feel special or valued
Maintain high ethical standards	Demonstrates high ethics in their interactions and fairness in their decisions

To augment the KEEN [2] definition and give multiple perspectives on Maker characteristics, the Five Roles framework [3] is also used. It was selected due to it being constructed from behaviors Entrepreneurs reported doing. Table 2 shows an excerpt from the Five Roles framework [3], the full framework is shown in Appendix 2.

Table 2: Five Roles Framework [3]

Roles	Attributes	Definition
Framing the Challenge (specifying highly challenging but realistic outcomes)	Performance Orientated	Sets high standards of performance
	Ambitious	Sets high goals, works hard
	Informed	Knowledgeable, aware of information
	Has Extra Insight	Intuitive
Absorbing uncertainty (taking the burden of responsibility for the future)	Visionary	Has a vision and imagination of the future
	Foresight	Anticipates possible future events
	Confidence Builder	Instills others with confidence by showing confidence in them
Path Clearing (negotiating opposition and clearing a path)	Diplomatic	Skilled at interpersonal relations, tactful
	Effective Bargainer	Is able to negotiate effectively, able to make transactions with others on favorable terms
	Convincing	Unusual Ability to persuade
	Encouraging	Gives courage, confidence, or hope through reassuring and advising

Participants and Data Collection

121 adult and young Makers between the ages of 5 and 60 years old were recruited at the New York and Bay Area flagship Maker Faires between 2013 and 2015. Artifact elicitation interviews [10], based on the qualitative inquiry approach of photo elicitation [11, 12, 13], were conducted with participants to understand the artifacts (projects) they brought to the Maker Faire. Sample

interview questions are shown in Table 3, questions like these were examined because they reflect entrepreneurial characteristics. For example, the question in Table 3 can also be interpreted as customer discovery and the probe asks about the market for their project. The interviews were then transcribed, and a subsample of 19 participants was selected from the larger set of 121 interviews by searching interview transcripts for the keywords in Table 4. Interview transcripts that contained at least one instance of the keywords were identified for use in this study. 8 of the selected interviews were from young Makers (18 years or younger) and 11 are Adult Makers (18+ years old).

Table 3: Example Interview Protocol

Example question:	How did you come up with the idea for this invention?
Example probe, if applicable:	What difference [societal impact] do you want your invention to have?

Table 4 Keywords

Kickstarter	Crowdfunding	Startup	Leader
Founder	Customer	Entrepreneurship	Investor

Analysis

A deductive thematic analysis [17] was used to understand how entrepreneurial mindsets overlap with Maker actions. The interviews were imported into the qualitative analysis software package Dedoose. Deductive coding was conducted twice on the interview data: once with the KEEN framework and once with the Five Roles framework.

Results

After coding the interviews using the two frameworks it became apparent that there was indeed Maker behaviors that fit the two frameworks. The two frameworks, although with different styles and definitions, were consistent in the attributes the Makers exhibited. For example, both frameworks indicate that Makers show leadership skills. Many Makers interviewed held leadership positions of organizations and young Makers were often leaders or founders of school clubs [16]. This shows an Entrepreneurial ability to lead and organize diverse teams. Other similarities included their ability to communicate effectively and a desire to improve. Both mindsets have fostered close knit communities which present their members with unique opportunities to learn and grow.

Five of the Makers interviewed had or were currently doing a Kickstarter with their project, 2 of these were young Makers. This shows that the entrepreneurial activates can start at a young age for Makers. Several others talked about doing ones in the future. This is a very entrepreneurial

activity and they all described this experience as a big learning process. One interviewee said, *“We learned a lot. For something to work, there has to be so many pieces to come together.”* (Nick, line 17) Maker projects are great examples of similarities in these two mindsets. The product the Maker makes in their project is basically what entrepreneurs would call an MVP (Minimum Viable Prototype). Many maker projects lack the bells and whistles but overall do the basic functions correctly.

The intersection between the Entrepreneurs and Makers is fascinating but perhaps more interesting is where they do not overlap. Using the KEEN [2] and Five Roles [3] frameworks several areas of entrepreneurship that Makers do not demonstrate were found. For example, the biggest area that Entrepreneurs and Makers differ in is customer development. Almost all maker projects are born from something the Maker is interested in doing or learning about. After that they show off the project and realize there is a market for it. In the case of a Maker who started a bicycle company he said, *“Just the response that that bike got alone, just from riding it downtown. So once we got that, we said let’s make a couple to see how it works and from then on it’s just taken off”* (Carlos, line 72). Entrepreneurs are taught to go out and interview people to find a problem or if they have an idea to verify it with real customers before proceeding.

Few Maker-Entrepreneurs have experience with business finance. The funding for a maker project often comes from creators’ paycheck (as money for hobby would) or from parents (in the case of young Makers), meaning that budgets are often limited. Many Makers do not get the experience of pitching their ideas to investors to receive capital as Entrepreneurs do.

Discussion

Both Makers and Entrepreneurs have unique focus areas. A discussion point to consider is: now knowing the nuances of these groups, how can they benefit from interactions with each other? The Entrepreneur could do the customer discovery and the pitching for funding. The Maker could provide the technical know how to make an MVP and be the technical expert in the pitch. Another way these mindsets could benefit each other is for the Maker to show off the product and help with marketing and business relations while the Entrepreneur does the financial side and pitching. Depending on the Maker and Entrepreneur there are many combinations of roles each could take to compliment the other.

Given that a project created by a Maker is analogous to a MVP, it could be used as the foundation for creating a startup. Perhaps the biggest thing missing from a maker project is the customer discovery. Makers prefer to make things they are interested in or solves their own problem rather than designing for other people. Adding this element into a maker project would increase its entrepreneurial value. Makers usually design for themselves or someone they are close to. Many successful entrepreneurs have taken a similar approach. Makers are proficient at this method and so this could help Entrepreneurs with their customer research.

Subjects could be taught using both entrepreneurship and making. One way that could benefit students is to do a mock startup focused on a subject they need to learn, such as physics. Some

schools like Arizona State University are trying a similar concept of learning engineering through entrepreneurship [20]. Given customer stories, students would design a solution and make an MVP. This process can be presented or pitched to increase communication skills. Then they could take this MVP to a real event like Maker Faire and talk to real people about it. This will not only give them good practice talking about their MVP but also, they can get some valuable feedback. Of course, there are many different ways to approach teaching through these mindsets and many different subjects that could be taught. Other subjects that have useful skills for Makers or Entrepreneurs such as engineering could be taught in tandem [18].

Conclusions

The analysis using the KEEN [2] and the Five Roles [3] frameworks have shown that Makers have many of the skills and traits needed for entrepreneurship. This led to the discussion and possible ideas for the future of making and entrepreneurship. This paper also investigated and discussed the potential benefit each mindset could have from cross pollinating from the other community. The desired impact is to show Entrepreneurs that Makers exist and that they show some characteristics that would allow them to get along with Entrepreneurs. Also by bringing Makers to their attention it opens up potential collaborators, markets, and workforce.

Future work could focus in on some of the specific ways Makers and Entrepreneurs already interact with each other. The current data set only hinted at this subject and it would be worth investigating to determine how these two groups are already interacting. This study could also investigate how one could instill more of the entrepreneurial mindset into Makers. The hope is to foster a more positive connection between Makers and Entrepreneurs.

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Appendix 1: KEEN Framework [2]

Business Acumen (This is the main code and the table is the sub codes)

Research Emphasis	Definition
Understanding of Economics	Shows they understand how money works
Understanding of Capital	Shows understanding where their money comes from and how budgets work
Good communication skills: listening, speaking, and writing	Being able to communicate their project, listening to and answering questions about it
Tolerance for ambiguity	*Making decisions with incomplete information
Vision	They can talk about the future of their project
Passion	Their mannerisms show they are excited about their project
Optimism	Having a positive attitude even when talking about failure
Persistence	Continuing to work through problems and failure
Ability to assess and manage risk	Listing pros and cons, or only talking a couple of risks when making decisions for the project
Leadership (sharing the vision)	Shows they can manage other people and make executive decisions and inspires the people around them
Understanding organizational structure and corporate culture (i.e. business practices)	Understands their organizations (school, Maker space, startup etc.) and can thrive in this location
Strong interpersonal skills	Able to discuss information with other people and can communicate effectively
Cross-team effectiveness	Shows they can work with people who have different skill sets and backgrounds than them
Understanding of the role of management	*Planning, organizing, directing, and controlling
Understanding the engineer's role within the organization	Asking the experts when needed to solve problems
Ability to resolve conflict	Demonstrates the ability to end conflict with an effective resolution

Understanding Customer Needs

Research Emphasis	Definition
Intuition	The ability to understand something immediately
Awareness	Aware of what customers need and of anything that needs to be taken into consideration from their background
Ability to identify and replace compensatory behavior	Being able to identify bad habits and take actions to remedy them

Research Emphasis	Definition
Ability to recognize an unmet need and to act on an opportunity	Being aware of needs and when an opportunity becomes available taking initiative
Inquisitiveness	*Asking questions, critical thinking
Ability to articulate and define a problem	Effectively communicating so both parties come to an understanding
Innovation	*The process of creating and delivering new customer value (Carlson et al. 2006)
Creativity	*Ability to think outside the box, changing the rules of engagement, redefining the boundaries of competition, or creating entirely new markets through disruptive technologies
Altruism	Belief in or practice of selfless concern for the well-being of others
Empathy	The ability to understand and share the feelings of another.
Prescience	Knowing how something will turn out before it happens

Societal Values

Research Emphasis	Definition
Value free enterprise	Shows this in their attitudes towards rules and regulations
Supporting personal freedom and liberty	Demonstrated attitudes or workplace policies that support personal liberty. Listening to individuals
Serve the needs of others	Project or startup is made to solve other people's problems
Internal customers (i.e. through teamwork)	Showing support for other team members
External customers (i.e. domestic and international customers)	Having good customer support and putting effort into making customers feel special or valued
Maintain high ethical standards	Demonstrates high ethics in their interactions and fairness in their decisions
Recognize and encouraging the development of future engineers; cultivate the next generation	Doing community events or helping others in the interest of helping the next generations

Research Emphasis	Definition
of engineers	
Maintain a global view	Being considerate and knowledgeable about world topics and cultures
Sustain environmental stewardship	Shows concern for environment and a desire for recycling or reusing
Have personal integrity, tenacity, courage, honesty, and a sound code of personal ethics.	Demonstrating these attributes in their actions and interactions

Technical Depth

Research Emphasis	Definition
Engineering analysis	Breaks down the project or solution into individual parts to be worked on or better defined
User requirements and performance specifications	Knows how to determine requirements and specification from interviews or another source of user info
Product innovation	Project or product is new and unique. Disrupts the current market or community
Hazard analysis	Being aware of hazards and knowing how to prevent or treat them
Design for manufacturing	Project or product was designed to be able to be easily mass produced
Design synthesis	The process of taken the functional architecture developed in the Functional Analysis and Allocation step and decomposing those functions into a Physical Architecture
Design characterization	Can come up with characteristics of the project such as intended use, market, themes, etc.
Design verification	Testing the design to establish the validity or effectiveness of the solution
Process validation	Collects and analyzes data throughout the design process to ensure an effective solution
Failure analysis	Can understand why something on the project failed and can identify how to fix it
Product qualification	Uses this process to certifying that a certain product has passed performance tests and quality assurance tests, and meets qualification criteria

Appendix 2: Five Roles Framework [3]

Roles	Attributes	Explanation
Framing the Challenge (specifying highly challenging but realistic outcomes)	Performance Orientated	Sets high standards of performance
	Ambitious	Sets high goals, works hard
	Informed	Knowledgeable, aware of information
	Has Extra Insight	Intuitive
Absorbing uncertainty (taking the burden of responsibility for the future)	Visionary	Has a vision and imagination of the future
	Foresight	Anticipates possible future events
	Confidence Builder	Instills others with confidence by showing confidence in them
Path Clearing (negotiating opposition and clearing a path)	Diplomatic	Skilled at interpersonal relations, tactful
	Effective Bargainer	Is able to negotiate effectively, able to make transactions with others on favorable terms
	Convincing	Unusual Ability to persuade
	Encouraging	Gives courage, confidence, or hope through reassuring and advising
Building Commitment (building an inspiring common purpose)	Inspirational	Inspires emotions, beliefs, values, and behaviors of others, inspires others to be motivated to work hard
	Enthusiastic	Demonstrates and imparts strong positive emotions for work
	Team Builder	Able to induce group members to work together
	Improvement Oriented	Seeks continues performance improvement
Specifying Limits (building a common understanding and agreement of what can and cannot be done)	Integrator	Integrates people or things into a cohesive, working whole
	Intellectually Stimulating	Encourages others to use their mind-challenges beliefs, stereotypes, and attitudes of others
	Positive	Generally optimistic and confident
	Decisive	Makes decisions firmly and quickly