Human Capability Initiative
مبادرة القدرات البشرية

Quantifying and Growing Individual Comfort with Uncertainty to Nurture and Support the Innovation and Entrepreneurship Culture

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Abstract: Silicon Valley is globally recognized for risk-seeking entrepreneurs, financiers, and corporate leaders looking to disrupt the *status quo*. The high risk associated with entrepreneurship and innovation stems from the near impossibility to foresee and mitigate all the risks that threaten a startup or disruptive innovation. These risks include technological risk, market risk, financial risk, regulatory risk, competitive risk, and personnel risk, just to name a few. Successful Silicon Valley entrepreneurs, venture capitalists, and founders possess two fundamental ingredients; (i) a risk-taking entrepreneurial mindset, which is buttressed with (ii) a robust entrepreneurial skillset. In this whitepaper, the foundational components of a risk-taking innovation-driven mindset are introduced, along with a novel methodology that leverages large language models and generative artificial intelligence to quantify such a mindset for individuals.

1.0 Introduction and Background

"Innovation" and "risk taking" are strong drivers in the highly competitive landscape of technology-focused businesses. As evidenced by quotes from tech corporate leaders, innovation – and a mindset that fosters innovation and growth – is key. To illustrate;

> *"Our industry does not respect tradition. It only respects innovation." – Satya Nadella, CEO of Microsoft*

> *"Sometimes when you innovate, you make mistakes. It is best to admit them quickly and get on with improving your other innovations." – Steve Jobs, Founder of Apple*

> *"The important thing is not to be afraid to take a chance." – Sundar Pichai, CEO of Google*

> *"To win big, you sometimes have to take big risks." – Bill Gates, Founder of Microsoft*

> *"The biggest risk is not taking any risk." – Mark Zuckerberg, CEO of Meta*

> *"I always did something I was a little not ready to do. I think that's how you grow." – Marissa Mayer, CEO of Yahoo!*

However, not every individual innately has a mindset that is comfortable with innovation and the level of risk and ambiguity often needed for disruptive innovation. Moreover, these quotes may be more stifling than empowering for some individual professionals, mostly due to the immense pressure to be continuously innovative at work. Before a professional can consistently begin to innovate, they must first understand if they already have the necessary mindset for

innovative thinking processes. If necessary, they can also learn and work to grow such a mindset with the proper support.

Thus, this paper delves into the reasoning underlying an individual's relationship with ambiguity, along with the correlation between innovative thought processes, comfort with uncertainty, emotional intelligence, and leadership skills. By deconstructing the individual elements of innovation, we can provide professionals with the ability to personally assess and develop traits that beget innovative thought processes. The most important aspect of the relationship between comfort with uncertainty, emotional intelligence, and leadership is that it is hierarchical. An individual's level of comfort with uncertainty is a foundation for both emotional intelligence and leadership skills. In other words, innovative thought processes are rooted in comfort with uncertainty (or ambiguity), from which stem enhanced emotional intelligence and leadership skills that all together enable innovative thought. This hierarchical relationship is shown schematically in Figure 1. [1,2] Thus, it is essential to first understand an individual's comfort level with uncertainty to understand if the mindset for innovative thinking processes is present or can be grown.

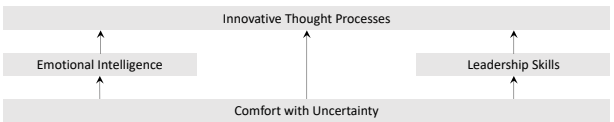

Figure 1. Hierarchical relationship of comfort with uncertainty, emotional intelligence, leadership skills, and innovative thought processes. [adapted from 1,2]

Since 2013, interviews conducted by de l'Etraz and Sidhu found that comfort with uncertainty is not a binary identity characteristic of "risk taker" or "risk avoider", but a complex spectrum that takes different forms depending upon boundary conditions and environments. [1,2] Specifically, extensive interviews with over 20,000 individuals from around the world have demonstrated the following findings.

- Over 80% of individuals assessed that were comfortable with uncertainty in their work life were not comfortable with uncertainty in their personal life. Essentially, an entrepreneurial, innovative professional mindset was most often accompanied by a more conservative personal life, thereby balancing the identity.
- Over 90% of test takers that were comfortable with very high levels of uncertainty at work were not comfortable with uncertainty in their personal life. Comfort with uncertainty in their personal life was strongly associated with them careers that were much more "certain" in nature, like librarians, controllers, etc.
- Only about 10% of respondents were comfortable with uncertainty in both their work and personal lives.

- A positive correlation is evident between greater comfort with uncertainty in work lives and a greater capacity for applying innovative solutions to professional problems.

This last finding, the establishment of a relationship between comfort with uncertainty and improved performance, innovation-focused or otherwise, is not novel. Over a century ago, researchers concluded that "[a]nxiety improves performance until a certain optimum level of arousal has been reached. Beyond that point, performance deteriorates as higher levels of anxiety are attained.", a phenomenon widely known as the Yerke-Dodson Law. [3] White illustrated the relationship between certainty, uncertainty, and optimal performance in Figure 2. [4]

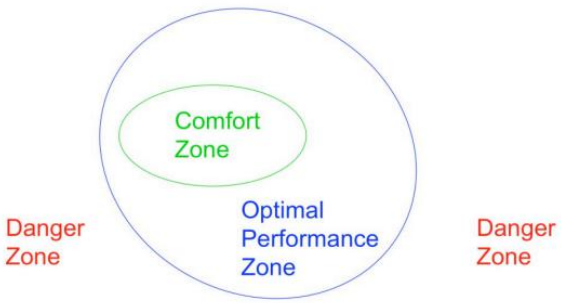

Figure 2. Relationship between certainty, uncertainty, and optimal performance. [4]

Beyond these seminal references, finding by de l'Etraz and Sidhu also supports the existence of relationships between comfort with uncertainty, emotional intelligence, and more innovative problem-solving at work, which are illustrated in Figures 1 and 2. They also found relationships between comfort with uncertainty and happiness. Over four years of interviews with hundreds of participants, de l'Etraz and Sidhu found the following. [1,2]

- A positive correlation exists between greater comfort with uncertainty in both work and personal lives with greater emotional intelligence.
- A positive correlation exists between greater comfort with uncertainty at work and career satisfaction.

With the goal of improving an individual's capacity to engage in innovative thought processes, happiness, and optimal performance at work, the literature [e.g., 1,2,3,4] suggests that increasing (i) their level of comfort with uncertainty, (ii) their emotional intelligence, (iii) and their leadership skills can be an effective approach.

As Peter Drucker once stated, "If you can't measure it, you can't manage it." Several assessment tools and metrics exist to measure an individual's emotional intelligence (e.g., ERC, EQ-i, MSCEIT, 360 EQ). Assessment tools and metrics

also exist to measure leadership skills and leadership potential (e.g., LPI, SLM). This whitepaper describes a metric and assessment tool to measure the third component of innovative thinking - comfort with uncertainty - which can then be used alongside these other assessment tools and metrics to improve an individual's capacity to engage in innovative thought processes and optimal performance at work. This results in an unlocking of human capability and innovation potential currently residing, yet unrealized and underutilized, in individuals and firms.

2.0 Quantifying Comfort with Uncertainty

Within the literature, the concept of "comfort level with uncertainty" is functionally substitutable with the concept of "comfort level with ambiguity." The authors have developed a two-part metric to quantify the level of certainty an individual needs to make a significant decision. This two-part metric is rooted in the observed dual nature of identity discussed previously in which a majority of individuals that have been interviewed by the authors over the past 10 years were not equally comfortable with uncertainty in their work life and in their personal life.

The two parameters used to measure comfort with uncertainty are a "P-score" and a "W-score". An individual's P-score indicates the level of certainty and amount of information an individual needs in order to feel comfortable when making a significant decision related to their personal life. An individual's W-score indicates the level of certainty and amount of information an individual needs in order to feel comfortable when making a significant decision related to their professional or work life. Each score is measured on a 4-point scale. Scores range from 1 (a very high degree of certainty is needed to make a significant decision) to 4 (very little certainty is needed in order to make a significant decision, with the decision becoming more instinctive in nature). [5] The P-score and W-score, as a measure of level of comfort with uncertainty in personal and work life, respectively, are illustrated graphically in Figure 3.

Figure 3. Schematic of P-scores and W-scores as a Measure of Level of Comfort with Uncertainty in an Individual's Personal and Professional/Work Life

When measuring the P-score and W-score across a total population of 725 individuals, Barbieri found that the majority of individuals lie in the middle of each range, identifying as moderately comfortable with uncertainty in both the personal and work aspects of their life. This is shown in Figure 4(left), with 72.9% of the population identifying as one of the following P-W combinations; P2/W2, P3/W2/, P2/W3, P3/W3. Also seen in Figure 4, Barbieri found that the

population is (on average) more comfortable with uncertainty at work than in their personal lives. For the population surveyed, the mean W-score is 2.552 while the mean P-score is 2.388. Among the population, Barbieri also identified three primary groups of participants: entrepreneurs, managers, and engineers. As shown in Figure 4(right), entrepreneurs have a higher average P-score and W-score than managers, who have a higher average P-score and W-score than engineers. [5] Given the nature of entrepreneurship, and the ambiguity associated with starting and building a new company, it is not surprising to see this trend in higher average W-scores. Further, given the design and safety responsibility associated with many engineering roles, it is not surprising to see this trend in lower average W-scores among engineers.

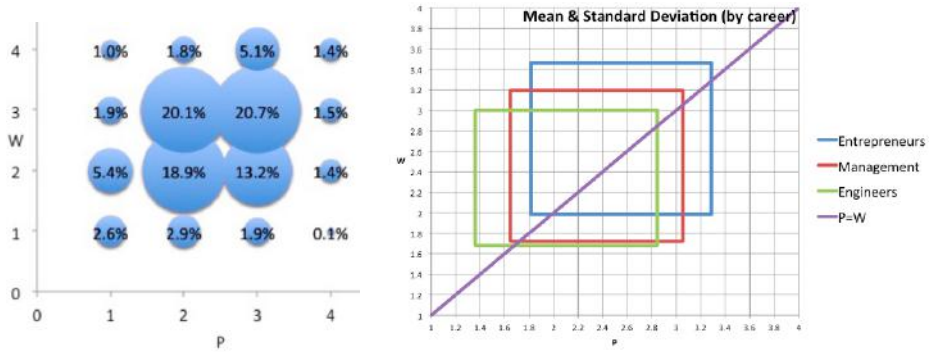

Figure 4. (left) Distribution of P/W-scores for a population of 725 individuals and (right) distribution of P-scores and W-scores for individuals identified as entrepreneurs, managers, and engineers. [5]

Building upon the prior interview-based work by de l'Etraz, Sidhu, and Barbieri, a computational model has recently been built using large language models (LLM) to query respondents for information regarding preferences and level of comfort in their personal and professional lives. In addition to collecting basic demographic data about the respondent, the LLM proposes a sequence of real-life scenarios for consideration by the participant. For illustration, the LLM may ask the respondent to agree or disagree with the following statement: "Before any test or challenge, I feel much less anxious if I know what its format will be." Based on the responses to a series of such queries, a P-score and W-score is calculated by the model.

The LLM-powered computational model has been validated against P-scores and W-scores that were self-assessed by each respondent after watching a 5-minute video lecture given by Dr. P. de l'Etraz that explains the underlying concepts and provides detailed examples of each type of P and W behavior. These self-assessments following the video lecture functionally replace the interviews that were carried out in previous studies by, for instance, the authors and Barbieri. With over 85% accuracy for P-scores and over 90% accuracy for W-scores, the computational model can successfully determine a respondent's P-score and W-score within ± 0.5 points. The complete probability distribution of differences

between each individual's self-assessment and the computational model is shown in Figure 5(left) for P-scores and Figure 5(right) for W-scores.

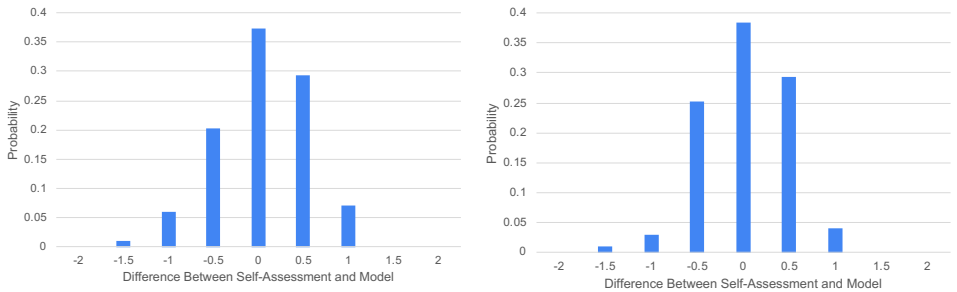

Figure 5. Probability Density of Differences Between Self-Assessment and LLM-based Computational Model of (left) P-scores and (right) W-scores

3.0 Leveraging P-Scores and W-Scores to Increase Human Capability

As shown previously in Figure 1, comfort with uncertainty, along with emotional intelligence and leadership skills, are the roots of innovative thinking processes. Fostering innovative thinking directly aligns with one of the strategic objectives of the Human Capability Development Program, specifically "Nurture and Support the Innovation and Entrepreneurship Culture." As shown previously in Figure 2, individuals demonstrate optimal performance when working in between their comfort zone and their danger zone. Understanding the boundaries of every individual's level of comfort with uncertainty as measured by P-scores and W-scores and empowering them to go just beyond their comfort zone is an important starting point in the Program's effort to fully harness an individual's and a society's innovation potential.

It is important to also note that an individual's comfort level with uncertainty can change over time. Barbieri found that P-scores and W-scores evolved over time, measuring P and W-scores first as a teenager, then at the time of survey (adulthood), and finally at an aspirational time in the future. [5] These results are shown for the population subgroups surveyed (entrepreneurs, managers, and engineers) in Figure 6. Barbieri noted that entrepreneurs were unique among the three groups in that they are only group to have significantly increased their level of comfort with uncertainty between teenage years and adulthood – in particular their comfort level with uncertainty at work (W-score). Barbieri attributes this phenomenon to their day-to-day work life being filled with ambiguous situations and circumstances. They have expanded their level of comfort with work-related uncertainty through repetition and habit, indicating that if an individual would like to become more comfortable with uncertainty in their personal and work life a training and development program would be effective. This observation is also supported by the work of the authors who have found that it is possible to teach others to raise their W-score, analogous to efforts that teach participants to improve their emotional intelligence (EQ) in the work environment. Tracking P

and W-scores throughout such a program would validate the efficacy and value of investing in such an initiative.

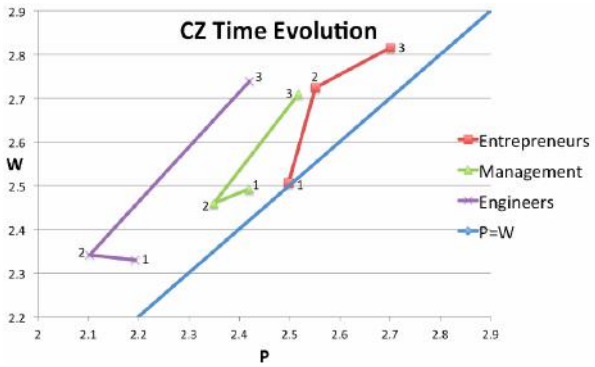

Figure 6. P-scores and W-scores of Entrepreneurs, Managers, and Engineers as a Teenager (Point 1), as an Adult (Point 2), and at an Aspirational Future Time (Point 3) [5]

Beyond empowering individuals to reach their full potential and capability, P-scores and W-scores can be used by firms to unlock hidden potential embedded throughout the organization. Several internal barriers have been identified in the literature to engaging in technology R&D, business model innovation, and new technology implementation. [6,7] From extensive literature study, these internal barriers can be broken down into four major sources, comprising the "COIL" framework to understand barriers to innovation.

Cultural Barriers to Innovation
- A firm culture that favors stability over risk-taking [*e.g.,* 8,9]

Organizational Barriers to Innovation
- High dependency is placed on embedded resources and the current organizational value network [*e.g.,* 10]

Incentive Barriers to Innovation
- Financial and resource constraints that limit innovation capability [*e.g.,* 11,12]
- An unsupportive firm structure and inappropriate incentive system that causes organizational inertia against innovation [*e.g.,* 13,14]

Leadership Barriers to Innovation
- Existing mental models prevent leaders from making risky decisions [*e.g.,* 15,16]
- Leaders place an over-reliance on previously successful business model [*e.g.*,17,18,19]

Within this COIL framework, three of the six underlying barriers relate to risk-taking, risky decisions, or reliance on comfortable business models. Engaging with individuals throughout the firm, from senior leadership to new hires, to better

understand and grow their level of comfort with uncertainty leads to unleashed innovation potential and development. Furthermore, work by Barbieri found that individuals are not only more innovative at work with increasing W-scores, they are also happier, with increasing satisfaction with their professional life. This is the case regardless of career choice, entrepreneur, manager, or engineer. Across all respondents studied by Barbieri, on average 60% of W1s were "satisfied with their professional life", while nearly 80% of W4s were satisfied. The relationship between level of comfort with uncertainty in work life and satisfaction with professional life was more pronounced for entrepreneurs. Barbieri found that 55% of W1 entrepreneurs were "satisfied with their professional life", while nearly 80% of W4 entrepreneurs were satisfied. Quantifying and growing the level of comfort with uncertainty for entrepreneurs at work, and therefore their satisfaction with an entrepreneurial career, is critical to broad objectives of building and nurturing entrepreneurial ecosystems around the world.

4.0 Conclusion

As discussed previously, this paper delves into the reasoning underlying the correlation between innovative thought processes, comfort with uncertainty, emotional intelligence, and leadership skills. Specifically, it focused on the deconstruction of the individual elements of innovative thinking processes. The authors found that the relationship between comfort with uncertainty, emotional intelligence, and leadership skills is hierarchical in nature, with innovative thought processes being rooted in comfort with uncertainty, from which stem enhanced emotional intelligence and leadership skills that all together enable innovative thought.

With a goal of building successful entrepreneurial ecosystems around the world, quantification of level of comfort with uncertainty in personal and work lives can be an important building block. The authors present a validated methodology for quantifying comfort level with uncertainty, and a novel computational approach that uses new large language models and generative artificial intelligence to assess individual comfort level with uncertainty at scale. Ultimately, the authors see this approach as a critical component of unlocking human capability around the world.

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