How Value is Created in Tokenized Assets

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Abstract

A tidal wave of change is coming to the world of Economic Science. Digital tokens—including bitcoin, altcoins, and cryptocurrencies—will require a fundamental rethinking of valuation, in the same way that the introduction of the stock market required a new understanding of value. As of this writing, the total value of all tokens stands at $500 billion. How do investors place value on computer code, with no central bank or physical asset to support it? Drawing from the literature on behavioral economics and tools from cognitive psychology, we aim to provide the first anchor to understand the criteria that investors are deploying to value new digital assets, making this the first study of applied behavioral economics on token valuation. Using a new instrument called the **Framework for Token Confidence,** we show how value can be created out of "thin air," and how tokens, and indeed the entire economic system, operate as something like a "vote of confidence."

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1.1 Introduction

In May 2010, an early bitcoin developer named Laszlo Hanyecz made the first public purchase using bitcoin.[i] He sent 10,000 bitcoin to another digital currency enthusiast, who placed an order for two pizzas to be delivered to Hanyecz's home. At the time, those bitcoin were worth about $40; today they would be worth $100 million.

The most common interpretation of this story is that Hanyecz overpaid for the pizzas. We suggest another view, which is that Hanyecz created enormous value by *building confidence* in the new technology. In fact, this purchase could be remembered as the historical equivalent of Alexander Graham Bell's first words spoken into the telephone: "Mr. Watson, come here – I want to see you." By making a real-world purchase using bitcoin, Hanyecz showed that bitcoin could have real-world monetary value. He gave confidence to the nascent developer community that bitcoin could be used as a new kind of digital currency.

That confidence was contagious. It has not only propelled bitcoin to a 2,500,000% increase since that historic purchase,[ii] it has also created an entirely new digital asset class of "tokenized assets," currently valued at $500 billion. In that sense, the pizzas were a deal.

How do investors value these digital assets? In most cases, they are not backed by assets, revenues, or guarantees. To dismiss the entire asset class as speculative, as some economists have done, is shortsighted. Why are some tokenized assets worth $10,000, and others worth practically nothing? By observing hundreds of new token launches, and measuring the success rate of each, what can we learn about investor behavior? Using this knowledge, can we predict which tokens are likely to increase in value? Can we identify the next bitcoin?

In this paper, we answer these questions using the well-understood concept of *investor confidence*. We lay out a new theoretical framework for how investors mentally value tokenized assets, when there are no "hard numbers" to evaluate. Finally, we introduce an analytical tool for token valuation, for the benefit of both token creators and investors: the Framework for Token Confidence.

1.2 Explaining Tokenized Assets

In 1997, the rock musician David Bowie introduced a novel investment vehicle called the "Bowie Bond." The brainchild of investment banker David Pullman,[iii] the Bowie Bond offered an interest rate of 7.9% with an average life of ten years (a ten-year Treasury note returned only 6.3%). The bond was backed by the expected revenues on David Bowie's back catalog of 25 albums, which could be reasonably expected to hold their earning potential over time.

Investors could be confident in the bonds, since they were given an investor-grade rating by Moody's,[iv] and ultimately purchased by Prudential Insurance Company of America for $55 million.[v] Bowie used the proceeds to buy back some of his master recordings, while still retaining ownership over his catalog. Rather than selling the rights to his music, in other words, Bowie used the bonds to buy them back.

The Bowie Bond is instructive, as it proved early on that even an intangible asset like digital music could be securitized. If digital music, then why not digital computer code? This is precisely what has happened with the new class of digital assets—including bitcoin and so-called "altcoins" like Ethereum, Ripple, and countless others—that we refer to as **tokens**. Like a traditional security, a token can be understood as a fractional share of value in an underlying asset or enterprise. We propose the following taxonomy:

- **Currency tokens** like bitcoin can be used to buy and sell real-world goods;
- **Platform tokens** like Ethereum can be used as "payment" to run transactions on a blockchain platform;
- **Asset-backed tokens** are tied to an underlying physical asset like real estate, fine art, or collectibles.

Today, blockchain technology is the "fuel" that allows users to store and transfer ownership of these tokens, since blockchain offers features like decentralized ownership and control, novel consensus mechanisms, immutability of data, trustless protocols and new governance models.[vi] While there are a wide range of use cases, *all tokens represent decentralized ownership of some underlying value*. Indeed, it is likely that we are entering a new "tokenized economy," where investors will be able to buy fractional ownership of any asset of value, from sports teams to cities and governments, with each transaction recorded on blockchain technology.

Given this transformative trend, it is imperative to understand how investors value tokenized assets. In the case of the Bowie Bond, it was backed by the expected future earnings from the artist's music. How do investors value tokens, which are not backed by companies or expected future revenues? Where does the value come from?

1.3 Tokenized Assets: From Concrete to Abstract

To answer these questions, we will first consider digital tokens backed by **assets of known value**, then **assets of uncertain value**, then **new tokenized assets**. We propose this taxonomy in order to move us from the concrete to the abstract, to better illustrate the mental shortcuts that investors use to place a monetary value on tokens.

1.3.1 *Tokens backed by assets of known value*

Consider a token that represents some underlying physical asset where the approximate price is known (e.g., gold, real estate, fine art, etc.). Like the Bowie Bond, these tokens are backed by a real asset or predictable revenue stream. As blockchain technology improves, it is likely that we will see a tremendous increase in the number of tokenized "real" assets. For example:

- **Real estate:** Investors in Mumbai will be able to own a piece of real estate in Manhattan, which will appreciate in line with the New York real estate market;
- **Collectibles:** Art lovers will be able to own a token backed by a Van Gogh painting, which will hold its value as long as Van Gogh's work remains popular;

- **Firms:** Venture capital firms will issue their own tokens, which will appreciate in value as investors develop more confidence in the firm's portfolio companies.

In each case, the token represents a fractional ownership of the underlying asset's value, but *not the asset itself*. (The very definition of a token is "a thing serving as a visible or tangible *representation* of a fact.")[vii] In this sense, tokens are unlike securities, which represent true ownership. With tokens, it is more accurate to say they represent a share of *perceived value*.

When the U.S. dollar was still on the gold standard, it was backed by physical gold. When the U.S. went off the gold standard, it was backed by a *social contract*: because it was widely agreed that the dollar has value, it has value.

The same social contract holds with tokens: as long as enough investors agree they have value, they have value. As more investors enter the market, or as investors grow more confident in the future value of tokens, they rise in value. When investors lose confidence, they fall.

Imagine a future in which the works of David Bowie are backed by the "Bowie token." The estate of David Bowie would then do everything possible to increase investor confidence in David Bowie's back catalog: licensing it for popular films, holding Bowie-themed music festivals, and so forth. In this way, they would be creating value for investors, and for themselves.

Thus, the value of a token backed by an asset of known value can be simply calculated as:

$$Value\ of\ one\ token = \frac{\text{Total value of the asset}}{Number\ of\ tokens\ Outstanding}$$

1.3.2 *Tokens backed by assets of unknown value*

With most altcoins, however, there is no "real-world peg" to the underlying asset. Yet the social contract determines that it does have value: billions of altcoins are bought and sold on digital exchanges every day. From where does this value arise?

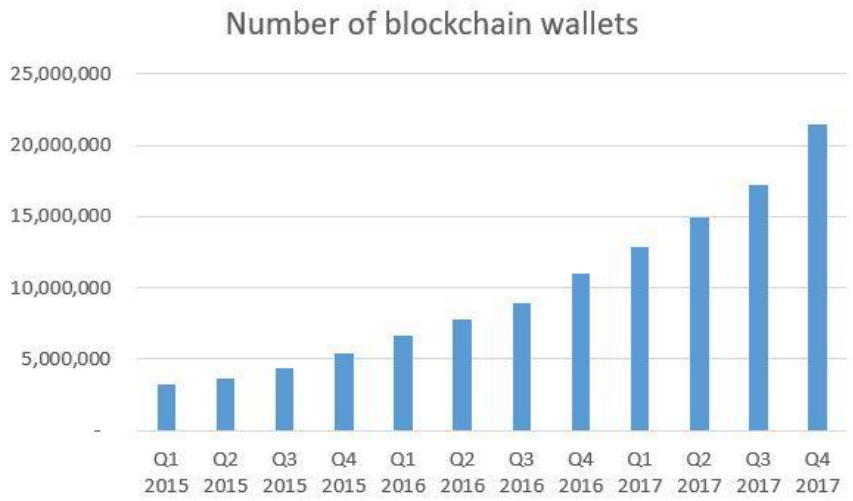
One way of approaching this problem is through **network effects**. Metcalfe's Law states that the value of a network increases in proportion to the number of users in the network. For n users in a network, the value to each user is proportional to the number of total users:[viii]

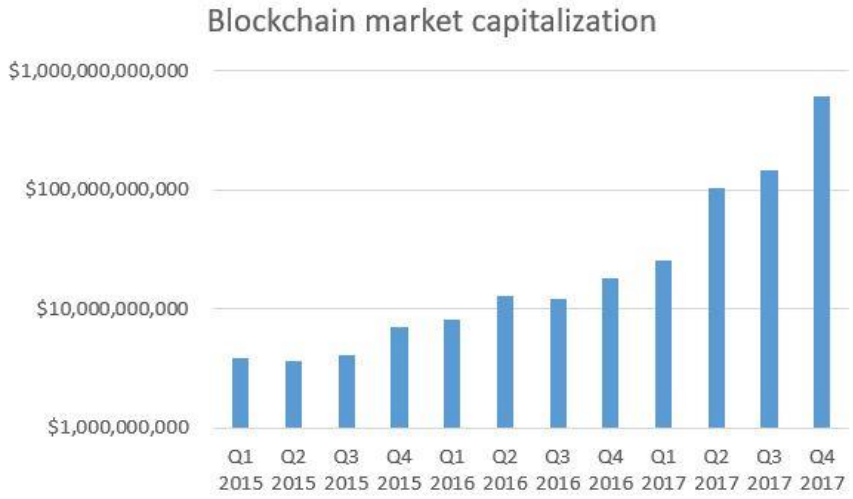
$$n\ x\ (n-1) = n^2 - n$$

Let us imagine a simple blockchain platform that is backed by a pool of 100 tokens. If each token has a value of $1 for every user on the network, then 10 users create a total value of $100, or $1 per token. Metcalfe's Law suggests that for every 10x increase, the network increases 100x: as the network grows

from 10 to 100 users, for instance, the total value of the network grows from $100 to about $10,000. However, *the number of tokens remains fixed*, so the token value increases from $1 to $100.

Indeed, this is precisely what we find when analyzing the growth in blockchain wallets vis-à-vis the total market capitalization of all blockchain assets:





Sources: Statista,[ix] *CoinMarketCap*[x]

This finding is significant, as it shows that Metcalfe's law applies to the value of digital tokens, but with a twist: since the number of tokens remains constant, the tokens see a disproportionate rise in value. This makes tokens unlike fiat currency: more people using dollars does not increase the monetary value of the dollar. Thus, the tokens that are likely to increase in value are the tokens with a large and established user base that is likely to grow in the future.

It should be remembered that distributed ledgers are powered by a decentralized nexus of computers that lend computing power to the network by solving complex mathematical problems, commonly known as "hashing." For so-called "Proof of Work" blockchains like bitcoin, the total computing power, or "hash power," is another way of measuring the value of the total network. Since hashing involves the real cost of electricity, it can be used as another measure of the total "value" of the network, as per Metcalfe's Law.

1.3.3 *New tokenized assets*

Where a new token is being created, without an underlying asset and without a network of users (e.g., through an Initial Coin Offering, or token sale), investors calculate prices subjectively, using whatever reference points they can.

To investigate how investors make these decisions, we held working sessions with approximately 250 token investors over a period of several months. We created a series of "blockchain investor meetups" in Boston and Cambridge, Massachusetts; for each meeting, we chose several highly-rated Initial Coin Offerings to analyze and discuss as a group.[xi] We asked participants to review the white paper for each ICO in advance, which laid out the business plan and technical specifics behind the project. We then facilitated the discussion around each ICO, observing the decision-making process of the investors. Finally, we asked participants to vote on whether they would personally invest in the ICO.

We found that investors looked for a variety of factors, including:

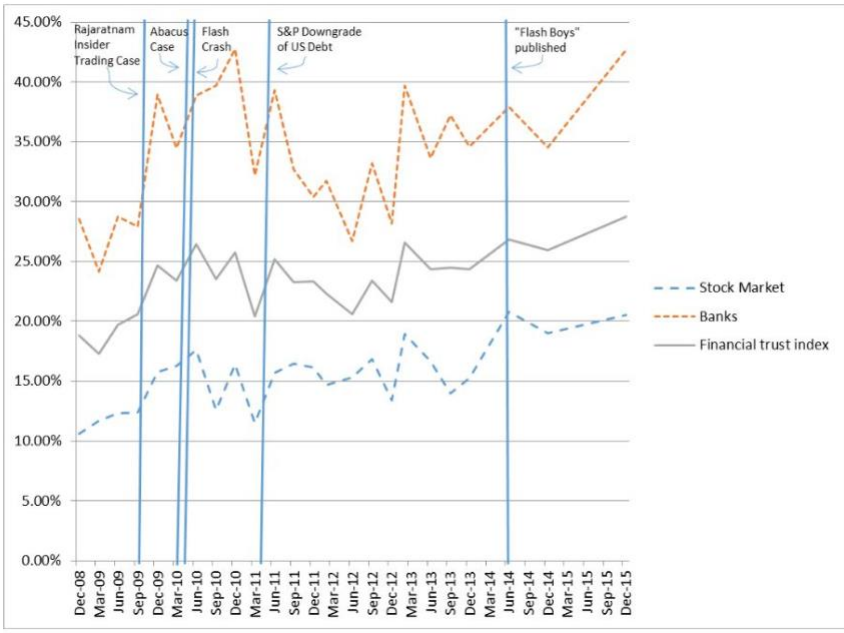
- **Team**: Does the founding team have a demonstrated track record of success?
- **Idea**: Does the token solve a real-world problem in some believable way?
- **Market**: Is the market strong and growing, or a shrinking niche?
- **User adoption**: How will they get both buyers and sellers to actually use the token?
- **Buzz**: What are other investors saying about the token? Is there a good deal of favorable PR?

We identified two types of ICO investors: those who planned to buy and hold for the long term, and those who planned to buy and sell as quickly as possible (hopefully at a profit). The slang term for long-term investing was "hodl,"[xii] where short-term investing was often called "pump and dump." Where the former were interested in strong ideas led by strong teams, the latter were more interested in the "hype cycle," hoping that a first-day trading spike would allow them to exit profitably.

Building on the Timmons Model of Entrepreneurship,[xiii] we created a rigorous method of evaluating ICO investment opportunities, identifying those that are most likely to lead to long-term user adoption, and thus enjoy the network effects of valuation outlined above. This model, the Framework of Token Confidence, is explained below. To understand its foundation, let's first look into the investor's mind: given future uncertainty and the lack of past performance as an anchor, what builds investor confidence in the first place?

1.4 Building Investor Confidence in Tokens

Confidence is an essential ingredient in any financial transaction. The buyer and seller must have confidence in each other; they must have confidence in the market in which they participate; and the market must have confidence in the institutions that govern it. A number of indices have been created to measure investor confidence, including the Yale Investor Confidence Index,[xiv] the ZEW Investor Confidence Index,[xv] and the State Street Confidence Index.[xvi]



Source: U.S. Securities and Exchange Commission Division of Economic and Risk Analysis[xvii]

The figure above shows that market movements are highly correlated with investor confidence, as measured by the Investor Trust Index.[xviii] We also accept this as a common-sense fact: the Fed chooses its words carefully to keep "market sentiment" high; the financial press talks about market downturns as "rattling" or "spooking" investors. These are all measures of confidence.

If confidence and market growth are correlated, how can the creators of new blockchain tokens create confidence, *before* the token has been assigned a value on public exchanges? Recent findings in behavioral economics, particularly the foundational work of Daniel Kahneman and Amos Tversky,[xix] provide some tantalizing clues into the minds of investors, and how savvy blockchain startups can focus their efforts to build investor confidence.

Familiarity: We trust what we know. This is the principle behind advertising, religious upbringing, and political dynasties. As Larry Jacoby demonstrated in his paper *Becoming Famous Overnight*,[xx] we are likely to view a new piece of information more favorably if we are already familiar with it. Expose test subjects to random names, and they are more likely to "remember" the names positively later on, even if they cannot

remember *how* they remember. Tokens that are able to build wide awareness are more likely to build confidence, and thus more value.

In our analysis of over 750 Initial Coin Offerings,[xxi] we found that sometimes founders were able to drive awareness through a larger advertising budget or better public relations, but often it was due to "grassroots" efforts—for example, building a strong development community, or leveraging existing networks of blockchain enthusiasts. The lesson is not that a larger marketing budget is necessary, but that token creators should focus on *building a strong network of users*.

The Halo Effect: We tend to assume that good-looking people are more intelligent.[xxii] This is known as the "halo effect," where one easily-recalled attribute is conflated with another attribute which is more difficult to discern.[xxiii] When investors view a company or a brand in a positive light, that tends to "rub off" on their view of the leadership team.

When deciding whether to participate in a new token offering, investors tend to attribute the "halo effect" to a founding team that comes from well-regarded companies or academic institutions. For example, the Dragonchain blockchain technology was originally developed by a team while working at Disney; when Dragonchain launched its $13.7 million ICO, Disney became part of the media story, even though Disney had no formal affiliation with the token.[xxiv]

To measure confidence in a new token, investors look for other symbols of confidence. When the token is connected with well-known technology brands (Uber, Google, Facebook), financial brands (Visa, PayPal, Apple Pay) or educational brands (Harvard Business School, Stanford, MIT), these are good signals that the halo effect is at work.

Intuition: The American economist Herbert Simon studied how humans make decisions, and his ideas were profoundly shaped by his pioneering work in the field of artificial intelligence. One of the topics that fascinated him was intuition: was it a distinctly human trait, or could machines also be taught intuition? He came to believe that intuition is nothing more than subconscious pattern recognition:[xxv] we've "seen this movie before." In other words, there is nothing magical or mystical about intuition: it is based on familiarity, which is why experts often "know" without "knowing how they know" (as popularized in Malcolm Gladwell's bestseller *Blink*).[xxvi]

When intuition is put head-to-head with simple algorithms, however, the algorithms win. Daniel Kahneman devotes a whole chapter to "Intuitions vs. Formulas" in his landmark book *Thinking, Fast and Slow*. His conclusion, after reviewing dozens of academic studies measuring "expert predictions" vs. "simple formulas": the formulas are more likely to predict winning outcomes.[xxvii]

The reason that intuition is unreliable when evaluating token offerings is that they are simply too new: no one has the requisite "10,000 hours"[xxviii] of experience in reviewing them to make intuitive judgments. Kahneman's work shows that investors would be better off making a simple formula of five to six different heuristics to evaluate an Initial Coin Offering. It is this framework that we offer below.

1.5 The Framework of Token Confidence

Babson College professor Jeffrey Timmons developed the Timmons Model of Entrepreneurship in order to assess the attractiveness of entrepreneurial ideas. It can be used by entrepreneurs seeking to develop a new product, as well as investors looking to evaluate an entrepreneur's idea. By rigorously asking the same questions across several different categories, the angel investor or entrepreneur can have an "apples to apples" comparison of different business ideas.

We have built upon the Timmons Model to make it more relevant to token offerings. For each question in the list, assign a value from 1 (lower potential) to 5 (higher potential). The score for each question is averaged at the end of each section, and the score for each section is averaged at the end.

	Higher potential (5)	**Lower potential (1)**	**Value**
Market			
Problem that it solves *Is there a clear problem solved by this token?*	Identified	Unfocused	
Customers *Can you clearly identify who will use this token (job title, demographics, etc.)?*	Reachable and receptive	Unreachable or unlikely to adopt	
Value created *If a user adopts this token, how much value will be added to his/her business or lifestyle?*	High and identified	None	
Market structure *What is the composition of the market this token will serve?*	Emerging or fragmented	Concentrated or mature	
Market size *Is the potential market too small, too large, or just right?*	$100 million+	<$10 million	
Regulatory risks *How likely are further regulations on this market, and tokens in general?*	Low	High or highly regulated	
AVERAGE MARKET SCORE *Average the six scores above*			
Competitive Advantage			
Technology/blockchain platform *Is the token built on a well-known standard blockchain, or it built from scratch?*	Existing blockchain	New blockchain	
Lead time advantage *Does the team have a head start on companies working on a similar idea?*	Strong	None	

Contacts and networks *What is the team's ability to access key players in this market?*	Well-developed	Limited	
AVERAGE COMPETITIVE ADVANTAGE SCORE *Average the three scores above*			
Management Team			
Entrepreneurial team *Does the team have a demonstrated track record of success?*	All-star "supergroup"	Weak team or solopreneur	
Industry/technical experience *Does the team have "10,000 hours" of experience in this industry?*	Super track record	Newbies	
Integrity *Does the team demonstrate scrupulous honesty, and complete transparency?*	Highest standards	Questionable	
AVERAGE MANGEMENT SCORE *Average the three scores above*			
Token Mechanics			
Token required *Does the problem truly require a problem, or is it a "bolt-on blockchain"?*	Impossible without	Token unnecessary	
Value added *Does the token add a new type of value, or is it "another one of those"?*	Highly differentiated	Copycat token	
Decentralized *Is it truly decentralized (like a mesh network), or is it run by the company (like a cell tower)?*	Users do the work	Company does the work	
Token supply *Is there a known quantity of tokens, or can more be issued in the future, diluting the value?*	Fixed, predictable	Uncertain, inflatable	
Public exchange *On which digital exchanges will the token be listed?*	Known, reputable	Unknown or disreputable	
MVP *Is there an existing product, or a Minimum Viable Product?*	Functioning product	White paper only	
AVERAGE TOKEN SCORE *Average the six scores above*			

User Adoption			
Technical difficulty *Will a non-technical person be able to understand this idea?*	Non-technical	Highly technical	
Halo Effect *Is the token strongly associated with well-regarded brands or institutions?*	Strong halo effect	Weak or no halo	
Buzz *Are people talking about it? Or is there silence?*	High social buzz	Low social buzz	
AVERAGE INVESTOR FRIENDLINESS SCORE *Average the three scores above*			
Overall Score *Average the five section values above*			

In practice, an overall score of around 3 is common, as most tokens (by definition) are average. A token with a score approaching 2 shows low investor confidence and should probably be avoided, while a score of around 4 indicates high investor confidence and is worth a closer look. As with any investment, this is not meant to be the end of the process, but a strong beginning.

For investors, the Framework for Token Confidence should be viewed as a tool for filtering out less attractive opportunities. For tokens that score highly, the investor will want to interview the founding team, seek out users of the token, and do a deeper competitive analysis.

For entrepreneurs or founding teams, the Framework for Token Confidence can be used as a tool for strengthening the idea. Better still, a knowledgeable third party is best positioned to fill out the Framework for Token Confidence most objectively, as founders are likely to score themselves more optimistically than an unbiased outside source. This is due to information asymmetries that exist between token creators and token investors, as well as the cognitive bias where "we can be blind to the obvious but also blind to our blindness."[xxix]

1.6 Conclusions

A tidal wave of change is coming to our economic system, in the form of blockchain technology. New asset classes—cryptocurrencies, altcoins, and tokens—are growing rapidly, and investors are looking for frameworks to value these new "tokens."

The key contribution of this paper is to provide a useful starting point for token valuation, based on existing theoretical and analytical tools, while also providing a novel framework for assessing token value. We rely on well-developed literature on behavioral economics and entrepreneurship studies, illustrating how these mental heuristics are directly at work in the minds of investors, and should be corrected for when making investment decisions. Hence, the study is simultaneously a first for the academic community as

well as practitioners. The next step of the study is to test the framework in the real world by augmenting it with actual data on the performance of tokens over time.

Tokens that are backed by a "real" asset (real estate, royalty streams, or precious metals) are fairly straightforward to value. The value of tokens not backed by a real asset—e.g., an altcoin like Ethereum or Ripple—can be estimated by looking at the total number of network users or total hash power (not to be confused with total tokens), in accordance with Metcalfe's Law. New token offerings—popularly known as Initial Coin Offerings—can be valued using the proposed Framework of Token Confidence, as these are likely to be valued more highly if they first build *investor confidence*.

Confidence is a critical ingredient for the successful functioning of our economic system. If enough people believe that something is valuable, it is—until they stop believing it. This is why we create elaborate structures around our largest societal institutions: the songs and stories of religion, the pomp and circumstance of politics, the rituals and rules of Wall Street. It is why bankers wear lapel pins with their bank logo, and why doctors wear white coats. These structures create confidence in these institutions, which gives them their legitimacy.

Aspiring entrepreneurs who wish to launch a new token, then, would be wise to build investor confidence through a) attracting a strong network of users, b) associating the token with well-known companies, and c) building familiarity with the token among investors in the blockchain space. This is sometimes called "building a brand," but an enduring global institution goes far beyond a brand. What is the brand of America? Islam? The military? These institutions are complex, with a "mental architecture" that stretches back centuries, each generation adding its own layer of interpretation.

To build long-term value in a token, then, it is necessary to build long-term confidence through institutional structures. Just as a religion has stories, scriptures, and songs, tokens that seek to build long-term value will incorporate origin stories, taglines, and advertising jingles. They will enlist the help of "elders," in the form of well-regarded advisory teams, and they will constantly convey their values in speech, habits, and dress. As an example, the founders of the Ripple token regularly appear at blockchain conferences wearing a lapel pin with the Ripple logo, in the manner of politicians.

Building investor confidence takes time. Investing in believable projects also takes time. Using the Framework for Token Confidence, both token creators and token investors can focus on building long-term value for the blockchain economy, and for the world.

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