

# Scaling, blockchain technology, and entrepreneurial opportunities in developing countries

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## ABSTRACT

Applications of blockchain technology (BCT) are scaling globally, especially in developing countries, where the opportunities that they exploit are often most prevalent. Achieving scale is vital for BCT ventures, which rely on network effects. BCT ventures seeking to scale employ innovative methods for scaling and also provide interesting insights on entrepreneurial scaling. We draw attention to three approaches that support scaling –promoting technology platforms, leveraging collective action, and navigating institutional contexts– and identify theoretically-grounded strategies for scaling related to these three approaches. We also build from the practical experience of cLabs, a BCT venture seeking to scale Celo, a mobile-first cryptocurrency blockchain platform focused on the developing world. We examine what BCT proponents like cLabs need to do to scale quickly and synthesize key insights, strategies for BCT ventures in developing **contexts, and opportunities for future research.**

## 1. Context: Scaling and Blockchain technology (BCT)

Entrepreneurs create value by exploiting recognized opportunities (Shane and Venkataraman, 2000). Scaling refers to entrepreneurs' efforts to grow their ventures across markets in order to maximize the value creation recognized in opportunities. Several aspects of scaling make it particularly interesting and unique. Scaling involves sustaining high rates of growth over an extended period of time while reducing the proportionate costs associated with this growth. Empirically identifying ventures that are scaling up often requires employing metrics other than employment or sales growth (Hellmann et al., 2016). Scale economies are very important in achieving scaling (Autio et al., 2018; Hennart, 2014; Monaghan et al., 2020). However, economies of scale can be achieved in different ways and different advantages can lead to scaling (Josefy et al., 2015). In particular, ventures that scale often rely on partners for capital and other contributions, utilize platform models (Nielsen and Lund, 2018), and move quickly to international markets (Coviello, 2019).

Since Bitcoin's first development in 2008, innovations based on blockchain technology (BCT) have scaled astronomically, providing an insightful context for understanding scale-up. BCT enables transactions among individuals anywhere in the world without relying on formal intermediaries (e.g., banks). BCT consists of distributed ledgers, or databases, in which transaction records are maintained across many (often thousands) independently operated computers/servers that verify transactions (see Cong & He (2019) for a BCT primer).

BCT scaling fits many of the characteristics of scaling previously identified and involves other unique and innovative features that promote scaling. First, BCTs form the basis of technology platforms, so similar to other scale-ups (Nielsen and Lund, 2018), BCT ventures achieve scale with platform business models. Second, scaling often requires collective action from various

types of external supporters (Nielsen and Lund, 2018). BCT ventures have leveraged typical supporters like the media and government officials, but also leverage others including code developers, validators, and token holders, all of which are vital to BCT scale-up. Some of the ways that these partners are involved leverage new digital affordances of BCT that allow anyone in the world to contribute to a BCT venture's scale-up. For example, initial coin offerings (ICOs) allow investors throughout the world to financially support specific BCT platforms (Fisch, 2019; Howell et al., 2020; Huang et al., 2020). This novel financing method (new methods continue to be created) helps to begin the process of scaling, but is only the beginning, as a BCT venture still needs to build a solution that is can achieve scale in the marketplace.

Finally, BCT ventures, like other scale-ups (Hennart, 2014; Monaghan et al., 2020), are usually born-globals, operating in multiple countries and seeking global adoption from inception (Reuber et al., 2021). Through their BCT, entrepreneurs often seek a large-scale disruption that is relevant in multiple contexts. New technologies create new entrepreneurial opportunities (Eckhardt and Shane, 2003). Typically, advanced technologies are developed in industrialized countries and later diffuse to developing countries (Comin and Hobijn, 2010). However, while most financial support for BCT has come from the developed world, the actual use cases delivered by blockchain ventures are more prevalent in developing economies with needs created by local institutional voids (e.g., ambiguous or vulnerable property rights; lack of trust in or limited capital markets, etc.) (de Soto, 2001). Table 1 illustrates a few entrepreneurial opportunities that are more attractive for BCT ventures in developing countries and for which BCT solutions are particularly well-suited. For these reasons, and despite a lack of resources and high technological know-how, 17 of the 20 countries with the highest rates of BCT use are in developing countries (Chainalysis, 2021). In being born global and looking to internationalize, largely within developing contexts where the opportunities (i.e., market needs) are more significant, BCT ventures can benefit in their scale up by using strategies to effectively navigate the difficult institutional contexts therein.

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In this paper, we focus on scaling among BCT ventures. We draw attention to three approaches to scaling – promoting technology platforms, leveraging collective action, and navigating institutional contexts – that are relevant to scale-ups, are built upon distinct theoretical foundations, and have unique application in the BCT context. Table 2 summarizes strategies for scaling related to these three scaling approaches. Blockchain platforms are based on open-source technology that can be easily replicated, so their success largely derives from being able to scale quickly so that users can gain benefits from others on the same platform. c-Labs is one example of an entrepreneurial venture, seeking to scale Celo, a mobile-first cryptocurrency focused on the developing world. In this paper, we examine what BCT proponents like Celo need to do to scale quickly. We conclude by synthesizing the key insights, deriving strategies for blockchain ventures in developing contexts, and highlighting opportunities for future research.

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## **2. Promoting Technology Platforms**

Platform-based business models enable rapid scaling, as they enable alignment of the activities of many independently operated organizations through technological interfaces (Piaskowska et al., 2021). BCT ventures often build a platform, and may also build this platform on top of other BCT platforms. For example, decentralized crypto exchanges are built on the Ethereum (e.g. Uniswap and Sushiswap), Cardano (e.g. Minswap and Sundaeswap), and Celo (e.g. Ubeswap and Mobius) blockchains. Thus, BCT entrepreneurs need to understand how platforms -- technological interfaces that connect people, organizations, and resources-- facilitate significant value creation and exchange, and thus enable scaling (Parker et al., 2016; Piaskowska et al., 2021).

Platforms are characterized by positive same-side and cross-side network effects (Katz and Shapiro, 1994). Positive same-side (direct) network effects arise as the value of the platform to each side (e.g., users) increases as more of that side adopt the platform, as there will be more potential parties with which to transact through the platform. Various sides (e.g. users, developers, validators/miners, founders, and investors) capture value when increased use of the platform occurs and transactions are facilitated among a larger, more diversified base of users. For example, as a cryptocurrency, Celo has more value with wider adoption given broader familiarity will enhance understanding and use. Positive cross-side (indirect) network effects arise when the value of the platform to a side (e.g., users) increases as more of the other sides (e.g., complementors) adopt the platform. If more producers or service providers use Celo, the value to users is greater because Celo could be used for payment for food, a haircut, or making a loan. Negative network effects may also arise due to congestion or deterioration in quality (Helfat and Raubitschek, 2018). For example, if the number of Celo users rises quickly, more transactions need to be verified, and if the number of transaction verifiers does not rise, transaction costs increase (a key issue for Ethereum currently). Network effects can lead one or a few platforms to gain critical mass rapidly and dominate the marketplace (Reuber et al., 2021). Below we discuss a few strategies that blockchain protocols might use to generate network effects around their platforms, spurring rapid scaling.

***Prioritize use cases.*** The scaling process often suffers from the chicken-and-egg problem, especially when disruptors have to gain the support of the very incumbents they seek to displace (Ansari et al., 2016). Given uncertainty and inertia, technologies and platforms evolve *slowly* through several phases, from initial application to single use cases to eventually transforming entire markets. BCT entrepreneurs benefit from focusing initially on specific use cases and consumer segments that offer attractive perceived usefulness and positive same-side and cross-side network effects. Platforms also can scale adoption by ensuring ease of access and use alongside security (Rogers, 2010). While many of the problems that BCT solves are most prevalent and severe in developing countries, these contexts lack technological ‘savvy’ and infrastructure like advanced computers and reliable internet access. Thus, focusing on use cases that require less infrastructure or learning of new technology are likely to scale more easily.

***Provide (monetary and non-monetary) incentives.*** Carefully designed pricing, subsidies, and incentives can serve to attract multiple sides to support the platform (e.g. Parker et al., 2016). Integrating the business activities of large and supportive incumbents into a platform might also generate momentum and positive network effects without requiring financial incentives. Safari.com and Vodafone launched a pilot of the M-Pesa mobile phone-based money transfer service in Kenya with the support of UK Government’s Department for International

Development. The service scaled even more quickly as a 5% discount was given for buying airtime using M-Pesa. These incentives contributed to the rapid scaling of M-Pesa, first in Kenya and then among the broader unbanked population in developing and emerging economies with weak institutions and technology infrastructures (Schilling and Shankar, 2019).

***Cooperate for technical standardization.*** Seamless compatibility between the platform and complementary technologies/innovations helps generate positive network effects. Open and standardized interface specifications enable decentralized and compatible innovations enabling a platform to rapidly increase its functionality and scope (Garud and Kumaraswamy, 1995). In BCT, forks represent cases in which innovators build an incremental extension of existing protocols, allowing the platforms to be leveraged in addressing new sets of needs without disrupting existing protocols. Open platforms are subject, however, to creeping incompatibilities and fragmentation through hard forks, or more significant changes in protocols due to disagreements on standards. Hard forks effectively create multiple incompatible technology standards based on the same original standard (see Simcoe and Watson, 2019) and reduce network size (and thus network effects), as users must choose between the new variants. Bitcoin has already experienced several hard forks, creating BCTs with the same original code (Bitcoin Genesis block), but with different current protocols (e.g., Bitcoin Classic, Bitcoin Cash) as innovators have experimented with different approaches to increase the bitcoin transaction rate.

In contrast, bridges, adapters, and connectors can mitigate incompatibilities in standards and increase the size of the network that can use a technology (Farrell and Saloner, 1992). Especially during initial stages of emergence, formal standardization efforts may instill confidence and reduce market uncertainty. Indeed, as blockchain use cases and applications proliferate (e.g., supply chain, cryptocurrencies, healthcare) and a variety of intra-firm (proprietary), inter-firm and industry-wide platforms (e.g., proprietary, consortium and public permissionless blockchains) emerge, compatibility issues may become more consequential. Thus, ongoing efforts to standardize blockchain specifications under the auspices of international standards organizations, like the ISO and IEEE, bode well. Additionally, BCTs designed to increase interoperability across different blockchain platforms are likely to be important for the future of BCT, so a BCT entrepreneur might prioritize cooperating with these interoperability-focused BCTs to stay within the set of interoperable BCTs.

***Anticipate and Address Governance Issues.*** Regulation across different countries or regions can also grow or diminish the size of a user network. Regulators may seek to apply inappropriate frameworks designed for older platforms and market contexts to new platforms (Sundararajan, 2017) or even ban them. Regulatory uncertainty and, at an extreme, regulatory capture by incumbents, may hinder system scaling, enabling incumbents to delay new entrants and buy time for themselves. For instance, top executives at major banks have bad-mouthed cryptocurrencies to delegitimize them and create market and regulatory uncertainty. With these hurdles, BCT proponents would benefit from working together. They can seek out friendlier jurisdictions where they can grow as well as participate in influencing regulation that will allow local scaling over time. Another, option to forestall either regulatory overreach or inconsistencies is to proactively implement self-governance embedded in the platform itself (Sundararajan, 2017) or self-regulation under the auspices of representative industry associations (Cusumano et al., 2021), as is happening in South Korea, Japan and the UK. Efforts to reassure industry stakeholders provide the starting point for any potential government regulation.

### 3. Leveraging collective action

One of the ways that ventures scale rapidly is leveraging support from others (Markman et al., 2019). Often support needed for rapid scaling is not based solely on technological or instrumental benefits, but rather on alignment with the ideals and norms espoused by the venture and other supporters of the venture (Busch and Barkema, 2022). Communication of this alignment is thus important for scaling (Shepherd and Patzelt, 2022). Social movements, or loose configurations of people and organizations organized to achieve a social goal (e.g. reduce climate change, expand voter rights), provide a fertile learning ground for gaining the support needed to achieve systematic change (Markman et al., 2019).

Social movement research indicates that three communication strategies—*selling visions, enticing participation, and claiming victories*—can help BCT ventures to form and mobilize coalitions (collectives) of supporters who help to scale the venture and BCT movement. These strategies, called “frames” (Snow and Benford, 1992), work by envisioning a better technological future that appeals to potential supporters, brings them together, and motivates them to contribute in desired ways. Many of the original developers of BCT were gravely concerned about a growing lack of privacy among computer users, centralization of power among technology companies and governments, and surreptitious data gathering, which were all made possible by rapidly increasing use of the internet. This coalition of technologists, which developed into the cypherpunk movement, provided the foundational ideals underpinning the development of BCT (Hayes, 2019). Many of these foundational beliefs, aspirations, motives, and principles tackled by BCT resonate naturally with an array of audiences.

**To sell visions** means to depict the value that a new technology promises to create for society, considering the shortcomings of extant technologies and the institutions and organizations that continue to support them (Waldron et al., 2015). The intent of this first step of framing is to create in the minds of many a vision of a better future and define the importance of reaching this vision. This strategy entails contrasting the social value of new and extant technologies from multiple (i.e. factual, emotional, and moral) perspectives, building from the audience’s existing visions. Activist organizations have long adopted this approach: they sanctify some industry practices as responsible or clean and demonize other practices as irresponsible or dirty to support their campaigns to transform such behaviors (Markman et al., 2019).

For instance, a BCT entrepreneur might emphasize the ways in which their BCT eliminates traditional banking requirements that inhibit many from opening accounts (factual), resolves unnecessary inequities in access (moral), and alleviates the associated hardships (emotional). Moral and emotional justifications for supporting BCTs might be particularly effective in initial efforts to appeal to potential allies. Although it seems extreme, demonizing extant financial institutions—such as by dramatizing the hardships faced by people who cannot access normal banking services—creates a powerful reason for potential supporters to care about the problems that BCT solves.

At the same time, radical technologies like BCT experience many drastic “ups” and “downs” as they mature, become more widely accepted, and coalesce into standard forms. The implication is that vision sellers can benefit from presenting development and implementation problems as things that should be expected and will be overcome. A recent example comes from issues with

Bitcoin's use in El Salvador, where technical problems, irregular transactions, volatility in crypto values, and identity theft have plagued the cryptocurrency's platform/ecosystem. These growing pains need to be acknowledged as part of selling the vision of a BCT-based future.

***Enticing participation*** means converting interested stakeholders into active supporters, providing reasons for them to contribute to the adoption of new technologies (Waldron et al., 2015). For instance, BCT entrepreneurs might educate consumers about new BCTs and develop applications to facilitate their use, turning to the business press to build public understanding and awareness of BCTs and the problems they solve. The intent is to create the impetus for coalitions of supporters to contribute the resources needed to build a better future. This strategy entails appealing to the interests of potential allies, depicting support for the new technology as the pathway to realize desired outcomes (incentive) and to avoid undesired problems (stigma).

BCT entrepreneurs, for instance, might emphasize how their technology brings opportunities for entrepreneurs to build new product applications that broaden access to banking services (i.e., incentivizing blockchain). Alternatively, they might emphasize how the technology creates reputational threats for media members, community organizations, and regulators who continue to align with traditional banking arrangements that constrain access (i.e., the stigma of extant solutions). Coalition builders face the challenge of selecting the approach that will resonate most strongly with their diverse pool of potential allies. Some, like entrepreneurs, might be more motivated by incentives (e.g., opportunity), whereas others, like media members, might be more motivated to avoid stigma (e.g., being caught on the wrong "side").

While BCT entrepreneurs might seek the legitimacy that comes from support by older and larger organizations, they are likely to have greater success in enticing younger and smaller ventures to participate with them in implementing their BCT applications. While many large companies have experimented with BCT, many of the early innovators in BCT are startups, often with the support of stakeholders interested in social impact. For example, with backing from the World Bank, the startup Agriledger has offered BCT solutions that help small-scale Haitian mango farmers maximize their profit by maintaining ownership of their crops until sale, confirming sales, and ensuring transparency along the supply chain (Leveille, 2019). By focusing on small-scale farmers with less to lose in taking a risk on a new technology, Agriledger demonstrated the ability to scale as well that might not have been possible in partnering with larger organizations.

***Claiming victories*** means leveraging the contributions and achievements of new technology supporters to bring more allies into the coalition (Waldron et al., 2015). This strategy allows initial technology supporters to "prove" their visions for a better future are being realized. Publicizing "success stories" of new technology generates opportunities to build even broader support. For instance, by promoting first movers' successes in innovating applications for consumers, supporters signal that the technology offers real opportunities for entrepreneurial action and social value creation. Such promotion also increases pressure on supporters of old technologies to embrace change. BCT entrepreneurs might be working on entirely different use cases for BCT, but they often point to the fact that El Salvador (and now two more countries) recognized Bitcoin as a form of national currency as a harbinger of positive futures.

#### **4. Navigating Multiple Institutional Contexts**

BCT ventures often seek to achieve global scaling, with non-location-bound advantages that lead to market dominance across many countries (Reuber et al., 2021). One way they do this is to substitute for government or private transaction intermediaries that perform similar functions globally. This is particularly useful in locations where local institutional imperfections disrupt predictable and orderly relationships and transactions. Institutions, or “the rules of the game in a society” (North, 1990, p. 3), embody both formal constraints (i.e., political systems, laws, regulations and rules, and the infrastructures that underpin them), and informal constraints (i.e., culture, traditions, practices, conventions and norms) (Peng et al., 2009). Many developing contexts are typified by institutional imperfections, such as burdensome administrative rules, widespread corruption, lack of legal enforcement, and poor-functioning capital markets (Acquaah, 2007). Furthermore, underdeveloped infrastructures, such as roads, railways, access to internet/broadband, new technologies, water supply and electrical grids, also have the potential of impeding market functioning (see Parente et al., 2019). These institutional imperfections create opportunities for BCT ventures.

***Partner with institutional aspirants.*** Institutional imperfections can be difficult to change, but offer globally scalable opportunities for BCT ventures. Despite the difficulty, some governments have made real strides to address specific institutional issues and escape a negative institutional reputation. For example, Rwanda has tried to be the Singapore of Africa by building a reputation for strong rule of law. BCT could be a tool for governments seeking to improve auditing and verification and elevate security and process verification standards because distributed ledger systems that are not controlled by a centralized entity, such as a government agency, offer greater transparency. In this way, BCT may help eliminate “grease payments” commonly used to expedite government decisions and processes. Thus, scaling of BCT ventures is possible in contexts in which governments seek to change the narrative around their institutional imperfections. Enhanced opportunities to address institutional imperfections may also arise when there are shifts in political conditions, such as when governments change hands, when new political alliances are created, or when exogenous changes necessitate change within government (Eckhardt and Shane, 2003). BCT entrepreneurs must weigh such windows of opportunity with governments seeking early “wins” against the turmoil and fragility presented by uncertain institutional conditions.

***Focus on “solvable” institutional problems.*** Specific institutional imperfections can be either more difficult or easier to solve. BCTs are likely not the solution for unreliable utilities or limited transportation infrastructure. However, BCTs can be more effective in addressing imperfections related to corruption, inefficient capital markets, and supply chain transparency. For example, entrepreneurs might showcase how a BCT can reduce the number of independent government agents required to carry out regulatory actions associated with specific transactions, since this can make it easier to monitor government workers (Bruhn, 2011). In this regard, governments have partnered with BCT entrepreneurs to develop systems that reduce the ability of government workers to manually alter documents (see Table 1). In a complementary sense, BCT can also lower the costs of regulation by focusing on transactions that currently require a lot of time from government workers. For example, smart contracts underpinned by BCT, which digitally define and execute the terms of a contract, might reduce the need for government worker discretion and potential for corruption (Cong and He, 2019). Addressing “solvable” institutional problems allows a BCT venture to scale to all the individuals affected by these problems.

***Seek institutional matches.*** Institutions exist at different levels and significant intra-country institutional differences exist (Webb et al., 2010). BCT entrepreneurs can search for a match with needed non-governmental partners. These include banks, ethnic or tribal leaders, or non-governmental organizations (NGOs) who can help to achieve scale and provide a stronghold to where users then achieve stronger network effects and more intense use of the BCT. Individuals in developing contexts can be wary of outsiders, and NGOs can serve as trusted partners helping to bridge entrepreneurs entering these markets (Webb et al., 2010). BCT entrepreneurs should also think of many of the different types of supporters (ethnic tribes, religious leaders who play an important role in legitimization of social life in tradition-focused communities, and can be interested in specific social issues), that might be readymade allies on which they can build. For example, blockchain protocols can work with businesses operating in developing countries that are built on ultra-low-cost business models to address or sidestep poor government recording keeping, weak legal enforcement, and government pathologies. Finally, BCT scaling requires a match with information and communications technology infrastructure, such as internet access and mobile phone penetration (Asongu et al., 2019). BCT entrepreneurs will benefit from focusing on the specific (smaller) areas that have the necessary information and communications technology infrastructure where a larger portion of the local community can adopt the BCT. Given a large heterogeneity and abundance in needs, focusing on a small set of institutional conditions before trying to tackle many, is more likely to build a solution that better fits local idiosyncratic needs. In all of these strategies, expertise developed outside of the context is likely insufficient, so BCT entrepreneurs can benefit from co-developing resources and expertise with local partners to support scaling.

### **Application: Celo**

One example of a BCT venture pursuing scale-up is Celo, a cryptocurrency founded in 2018. Celo users can use their mobile phone to easily hold, transfer, borrow, and lend cryptocurrency to anyone else with a mobile phone. With use across 100 countries, CELO tokens are less subject to the local currency inflation or economic or political volatility than existing currencies. Moreover, while most developing economies continue to print new money, exacerbating inflationary pressures, the supply of CELO tokens is capped at 1 Billion. Celo has achieved widespread scale-up by leveraging a number of the strategies, as summarized in Table 2. In addition to notes in Table 2, we discuss some of the particularly interesting issues in scaling BCT that arise from these approaches.

With respect to promoting technology platforms, BCT scaling is theoretically interesting in that actual use cases are strongest in countries suffering from similar institutional problems. This is a tremendous opportunity, at the collective level. However, technology-based scaling can create economic frictions that can have negative consequences for some individuals, including the poor. It is unlikely that there will be just one winner among BCTs, but as has already been experienced, many existing chains and platforms are likely to disappear over time as competition and network effects of leading BCTs take hold. Users of BCTs that later disappear may be harmed. Scholars might help the BCT community to create mechanisms for lessening any negative impacts, especially on the poor. Scholars can inform more effective efforts for building technical bridges across chains and platforms to allow users to transition between BCT standards, which is particularly important as particular BCTs begin to fail. How exactly to do this going forward is unclear. One effort by CELO is to allow payment of gas fees (i.e.,



payments made by users to validators for validating blockchain transactions) in CELO, rather than in ETH tokens, in order to reduce transaction costs, reduce lock-in to the ETH ecosystem, and to promote adoption.

In relation to leveraging collective action, the number and variety of ecosystem participants that are needed to support a BCT, and the variety of reasons for which they might support a BCT, is particularly interesting. BCT ventures are collectively selling visions, enticing participation and claiming victories for the entire BCT industry as well as individually for their own specific BCT protocol. Moving forward, it will be important to understand how these framing processes are not just communicated to stakeholders, but embedded in the BCT code and governance mechanisms, and how that builds support for specific BCTs. For example, Kickstarter recently adopted CELO as the blockchain infrastructure on which its crowdfunding transactions will be based in the future because CELO is carbon negative (i.e., a significant criticism of other leading BCTs has been the high energy needed to support transactions) and enables borderless transactions. Kickstarter's selection highlights how the values underpinning platform protocols influence scaling patterns. The rules and values embedded in a BCT protocol influence the type of entrepreneurs who participate as validators (a new organization type that is vital to ensuring timely, efficient, and secure transactions) in turn will influence the impact of BCT on specific communities.

Relative to navigating multiple institutional contexts is the important role of local NGO partners with trust and networks to facilitate scaling within local communities. For example, during a strict COVID-19 lockdown in the Philippines, Celo partnered with Grameen Foundation to distribute cash aid to thousands of female entrepreneurs to support their household needs (Kalaw, 2021). Use of CELO helped reduce the transaction costs and time required to deal with a large number of transactions and, in turn, helped to create a local community of users that used Valora, the digital wallet application created for CELO. BCT entrepreneurs might also consider how to align coalitions of various actors and stakeholders. Effective alignment requires rallying around a specific subset of the values associated with the broader BCT movement. For example, Celo is a member of the Alliance for Prosperity, which brings together various organizations (for-profit and non-profit) aligned with the mission of enabling digital money transactions that are faster, more transparent and less costly. Moving forward, these coalitions are likely to influence not only whether a BCT scales, but how BCT looks in the future (e.g. how BCT systems will prioritize transaction costs, security or transaction speed)

## **Conclusion**

In the coming years, some of the many nascent blockchain ventures are likely to scale up rapidly and revolutionize capital markets, property rights systems, and supply chains. This scaling will likely occur fastest in the developing world. The three approaches for scaling (promoting technology platforms, leveraging collective action and navigating multiple difficult institutional contexts) outlined herein suggest a number of strategies that blockchain ventures can leverage to scale. Celo's efforts to scale highlight nuanced considerations in implementing these strategies. Researchers can play a role in understanding and perhaps influencing how BCT ventures scale.

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*Table 1: BCT Solutions compared to Status Quo*

Problems	Current solutions	BCT-based Opportunities (with example BCT projects)
Local currencies are weak, subject to high inflation, and many local citizens (half the world) are unbanked <sup>1</sup>	Political leaders or economic appointees create local money supply, typically choosing inflationary measures, making it difficult for locals to save or invest. Capital controls in some countries bar locals from holding foreign currency. Many use USD, EURO or another country's currency or physical assets for savings. Small savings of poor are in cash or physical assets (subject to theft). Some adoption of mobile banking technologies (e.g. M-Pesa).	Any person in any location can transact in any BCT. Supply of blockchain tokens (e.g. Bitcoin) is limited by code. Some blockchain protocols allow for limited inflation, others are strictly non-inflationary or even deflationary. Low transaction fees make small savings possible. Example: Use of Bitcoin in El Salvador, using Bitcoin lightning network
Supply chains are insecure, allow counterfeit goods	Customers must trust third-party certifications or a firm's own private records to verify product authenticity and quality.	A distributed ledger that is publicly viewable shows each step where data is entered into the system along the supply chain. Example: Vechain.
Remittances to developing countries are costly and sometimes slow	Transaction costs globally average 7% (remittance companies) and 11% (banks). <sup>2</sup> Larger transfers are more costly, require multiple days of waiting.	Blockchain addresses have no geographic location. Transaction costs vary by blockchain protocol, but several options are less than 0.01%. <sup>3</sup> Example: Stellar Lumens.
Lack of properly recorded property titles	Ownership based solely on possession. Title transfer requires costly legal actions. All property records stored at government, often written by hand on paper; easily changed by corrupt officials.	Property records recorded on publicly viewable blockchain with static attributes (e.g. location, size), dynamic attributes (e.g. current owner, zoning), and events (e.g. ownership transfer) <sup>4</sup> . Any changes are permanently recorded, and are thus traceable. Example: Consensus partnership with Indian government.

<sup>1</sup> (Cull et al., 2012)

<sup>2</sup> (Ahmed et al., 2021)

<sup>3</sup> (Senatus, 2021)

<sup>4</sup> (Saibaba, 2019)

*Table 2: Strategies for scaling adoption*

Scaling Approach	Scaling strategies	Blockchain-specific scaling applications	Application by Celo
Promoting Technology Platforms	Prioritize use cases	<ul style="list-style-type: none"> <li>• Focus on scaling initial use, rather than worrying about later stages</li> <li>• Focus on use cases with positive network effects AND high perceived usefulness</li> <li>• Limit required technological learning or infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>• Mobile-first application, reliability, ease of use for developing countries (send from mobile based on phone numbers, not complicated blockchain codes)</li> <li>• Developed lower cost onramps (i.e., transferring between blockchain and traditional currencies)</li> </ul>
	Provide (monetary and non-monetary incentives	<ul style="list-style-type: none"> <li>• Seek support of large companies (e.g. MNC CSR initiatives) to scale BCT scaling</li> <li>• Provide discounts to users or complementors for helping to scale BCT</li> </ul>	<ul style="list-style-type: none"> <li>• Promotes developers within Celo ecosystem by providing funding, mentorship and connections to developer talent</li> </ul>
	Cooperate for technical standardization	<ul style="list-style-type: none"> <li>• Avoid hard forks of technology</li> <li>• Use third party standardization bodies to establish standards that apply to all BCTs</li> <li>• Coordinate with BCTs that promote interoperability</li> </ul>	<ul style="list-style-type: none"> <li>• Protocol based on a soft (not hard) fork of Ethereum. Maintains compatibility with Ethereum ecosystem.</li> <li>• Bridges to other blockchains (Optics bridging standard reduces transaction costs and promotes adoption)</li> </ul>
	Anticipate governance issues	<ul style="list-style-type: none"> <li>• Work with other BCT entrepreneurs on governance</li> <li>• Pursue self-governance or self-regulation</li> <li>• Focus early scaling in friendly jurisdictions</li> </ul>	<ul style="list-style-type: none"> <li>• Prioritized focus on countries interested in crypto</li> </ul>
Leveraging Collective Action	Sell visions	<ul style="list-style-type: none"> <li>• Build on an audience's existing frames</li> <li>• Utilize factual, emotional, and moral perspectives</li> <li>• Incorporate “ups” and “downs” into roadmap to achieving vision, or part of the vision</li> </ul>	<ul style="list-style-type: none"> <li>• “Banking the unbanked” and “mobile first” mission to provide financial access to the next billion</li> </ul>

	Entice participation	<ul style="list-style-type: none"> <li>• Bring audience into the new vision</li> <li>• Match action motivation (incentive vs stigma) to audience</li> <li>• Include entrepreneurs as critical first adopter participants</li> </ul>	<ul style="list-style-type: none"> <li>• Incentives: Growth in value of CELO (users), returns on platform services (validators), carbon negativity (partners)</li> <li>• Exclude validators not meeting reliability, security and efficiency requirements</li> <li>• Incentivize validators through grants to build transaction infrastructure</li> </ul>
	Claim Victories	<ul style="list-style-type: none"> <li>• Share success stories</li> </ul>	<ul style="list-style-type: none"> <li>• New service launches, partner relationships, milestones achieved</li> </ul>
Navigating Multiple Institutional Contexts	Partner with institutional aspirants	<ul style="list-style-type: none"> <li>• Find governments working on specific institutional imperfections that BCT can help address</li> <li>• Seek institutional windows of opportunity</li> </ul>	<ul style="list-style-type: none"> <li>• Cautious approach, looking for crypto-friendly governments, local needs (e.g. hyperinflation and need for stablecoins)</li> </ul>
	Focus on “solvable” institutional problems	<ul style="list-style-type: none"> <li>• Fit corruption-reducing BCTs to contexts with fewer institutional agents</li> <li>• Match cost-reducing BCTs to time-consuming transactions</li> </ul>	<ul style="list-style-type: none"> <li>• Cooperate with NGOs implementing universal basic income payments to poor<sup>5</sup>, as well as micro-work in Africa (captioning photos in return for CELO micropayments)</li> </ul>
	Seek institutional matches	<ul style="list-style-type: none"> <li>• Search for goal-aligned non-governmental partners</li> <li>• Concentrate where ICT infrastructure is stronger</li> </ul>	<ul style="list-style-type: none"> <li>• Prioritize areas with infrastructure, phone, internet, digital payments ecosystem, onramps to crypto (ATMs, crypto exchanges), community acceptance</li> </ul>

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<sup>5</sup> (Celo, 2021)