



Blockchain Technology

Can the GCC Digital Economy Thrive Without It?

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Blockchain in Context

The Gulf Cooperation Council (GCC) region is undergoing a period of rapid change as governments strive to diversify away from petroleum-based assets to a broader knowledge-based economy with smart technology at its core. But, as the focus on digitization increases and smart cities rise up to support national agendas, governments need to be increasingly prepared for threats ranging from hacktivism to cybercrime.

National strategies across the GCC are already being developed to protect:

- **Regional banks:** Ransomware exposes sensitive financial data, eroding consumer trust and causing subsequent revenue losses in the billions of dollars.
- **Oil and gas facilities:** Destructive malware could destroy corporate information technology (IT) assets and industrial control infrastructure, reducing hydrocarbon production, which is the economic lifeline of regional economies.
- **Power grids:** Cyberattacks can potentially impact power grids, and such strikes may hit during periods of extreme temperature, when electricity consumption is needed most.

However, while such protection strategies are constantly evolving, so too are the threats.

Therefore, across the Arabian Gulf, new approaches to managing cybersecurity threats are needed for economies to continue to keep up with the cyber attackers, who grow more sophisticated, more coordinated, more adaptive, and more resilient each day.

It is imperative that these approaches develop in a way that supports the realization of regional smart city ambitions and the security of GCC nations. From the UAE to Qatar to Saudi Arabia, as Gulf countries seek to create some of the world's smartest cities and a culture of innovation, blockchain technology is becoming an indispensable tool in the quest for success. Known primarily as the public ledger of Bitcoin transactions, blockchain offers a more streamlined and effective way of enabling digital trust and has the power to:

1. **Protect and enable** smart city development
2. **Disrupt** digital transaction systems
3. **Incubate** a startup ecosystem to drive economic growth.

This report explores the what, how, and why behind blockchain technology, highlighting its real-world applicability across industries—healthcare to automotive, to finance—while demonstrating how governments can extract tangible value from the vast amounts of data at their fingertips.

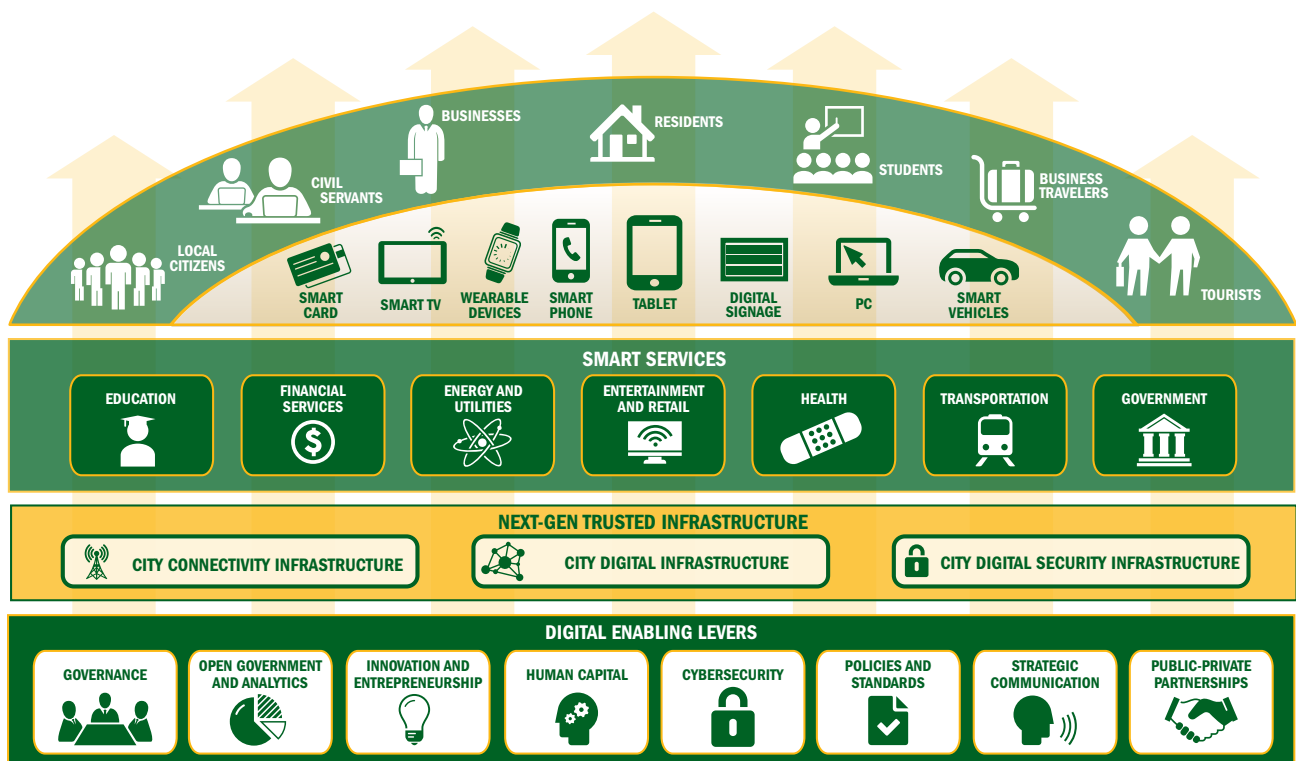
Everywhere we look, digital advancement is changing the way we interact. From commerce to government services, almost every aspect of daily life is touched by game-changing technologies. As they grow in scale and sophistication, they are spawning not only a new breed of consumer but also a new breed of city, designed to meet rising demands for instantaneous service at minimal cost. The evolution is exciting, but the digital wave now engulfing our world brings with it challenging undercurrents to test even the most adept of digital economies. The stakes are high but, determined to secure its place among the global frontrunners, the GCC, a region where Internet penetration is expected to reach almost 68 percent next year,¹ is opting to embrace technological change through innovation of unprecedented proportions.

Until recently, Gulf ambitions were manifested in skyscrapers and superlatives: *the biggest, the*

best, and the boldest. But superlatives are no longer enough. In the face of volatile oil revenues, the need for economic diversity, and a tech-savvy population that expects convenience at the touch of a button, **the region now finds itself in pursuit of an entirely different kind of paradigm: *smartness.***

With Masdar City in Abu Dhabi and Lusail City, Qatar, serving as brick-and-mortar evidence, regional leaders are taking the quest for innovation seriously and have already taken important strides toward building smart facilities in areas as diverse as waste management and parking. And the potential economic impact is proving attractive, too. The global digital services market is conservatively forecast to reach \$1.2 trillion in 2018, up from \$768 billion in 2013.² Although the MENA region—including the GCC—is expected to account for just 2 percent of that sum, it is estimated that digitization will boost gross domestic product (GDP) by \$5.5 billion in Dubai alone during the same 5-year period.³

Exhibit 1 | Booz Allen View of the Digital City



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¹ Arab Knowledge Economy Report 2014

² Digital Planet, Booz Allen Hamilton analysis

³ Digital Planet, Booz Allen Hamilton analysis

To turn financial forecasts into tangible results and nascent projects into city-wide success, governments must now build on the progress made so far. **This requires the creation of solid strategies that manage their cities' fundamental assets through secure information and communication technology (ICT) integration and foster a digital ecosystem with next-generation trusted infrastructure at its core.**

Blockchain: Protect and Enable Smart City Development

The creation of such an ecosystem, however, does not happen overnight, and even the most advanced of digital economies face difficulties. To combat the challenges, the next-generation infrastructure must look beyond conventional approaches, which have yielded modulated growth. Instead, a new way of providing high-assurance, high-trust infrastructure is needed—one that can scale, perform, and adapt to a rapidly accelerating and transforming digital economy. These new approaches must share data across all smart service domains in a secure way and de-risk the current convoluted and complicated approach to cybersecurity. **Blockchain has now been**

recognized as a potentially game-changing approach to cybersecurity, and its applicability to the smart city context is profound.

Blockchains have risen to the fore in recent years as the public ledgers of Bitcoin transactions, but their uses are far broader and momentum is rising. Described as a generational disruptive force in the financial services industry, these distributed ledgers maintain tamper-proof lists of ever-growing data records and enable secure value exchanges—money, stocks, or data access rights—between different parties.

Unlike traditional trading systems, no intermediary is required and the need for a central recording system to track the exchange is removed. Instead, the parties involved in any transaction deal directly with each other.

In summary, where command and control characterize conventional transactions, speed and participation are the defining features of blockchain technology.

Blockchain and Conventional Transactions Compared

Conventional Transactions

Using conventional methods, any transfer of value requires a trusted third party, such as a clearing house. This increases the time required to complete the exchange while also increasing overhead. In the case of financial transactions, individuals notify their bank that they wish to make a transfer. The bank then moves the money to a clearing house, which maintains a centralized ledger to track all exchanges and transfers the money to the recipient's bank. The recipient is then notified by the bank that the deposit has been made. The process is complete, but it has been costly and time-consuming. (See Exhibit 2.)

Blockchain in Numbers

\$921 million in cumulative venture capital investment in blockchain and Bitcoin companies as of October 2015 (\$462 million in 2015 alone).

805 early-stage Bitcoin and blockchain companies identified by Venture Scanner.¹

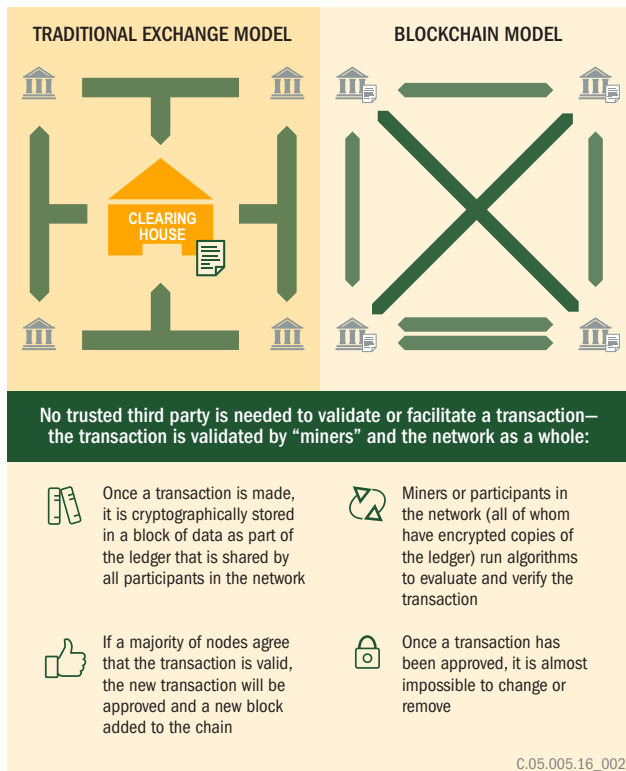
30+ banks and financial institutions known to be testing, analyzing, or investing in blockchain technologies.²

¹Venturescanner.com, reviewed November 2015

²FirstPartner research

Source: Richard Warren, rwarren@firstpartner.net

Exhibit 2 | Traditional vs. Blockchain Transactions



Blockchain Transactions

The blockchain experience is altogether different. Here, an individual opens his or her cryptocurrency wallet and sends money directly to his or her chosen recipient. Miners then validate transactions by performing complex proof-of-work calculations. The output of these calculations is recorded in a shared ledger and duplicated across the network in a blockchain. Next, the recipient receives the cryptocurrency and either spends it in its current form, or converts it to dollars. Transactions are stored in blocks on the ledger. Multiple validated ledgers are held by all nodes on the network to prevent forgery, and the ledger is updated several times an hour. No intermediary is required, and the transaction is both fast and secure. (See Exhibit 2.)

The Challenges of Life in a Digital World

Cultivating a Digital Ecosystem:

The Issue of Cybersecurity

In any transaction, security is a prime challenge. The Internet is the ultimate network of networks—a global system so powerful it can respond to requests in tenths of a second, connect people across continents like never before, and execute transactions in the blink of an eye. However, in cyberspace, where hits are growing in both strength and number, **the question is not if a cyberattack will occur, but when.**

Recent statistics drive home the seriousness of the situation: **average annual losses to companies worldwide from cyberattacks now exceed \$7.7 million per organization**, according to the Ponemon Institute.⁴ Counting among the most notable cases to hit GCC shores was the Shamoon virus attack, which shut down more than 30,000 workstations at Saudi Aramco in 2012.

Governments have ramped up their security efforts in the wake of such threats, but while ever-advancing security measures are being developed, so too are new and sophisticated cyber threats to thwart them.

The Problem with Public Key Infrastructure

GCC initiatives such as national identification and public key infrastructure (PKI) programs that rely on biometric data have been designed to create a trusted digital chain of authority. A critical component of PKI is the digital certificate, an electronic document that associates the identity of an individual with the public key associated with it. It can then be further linked with a person, company, or a web service as a portal. The certificate is issued by an organization known as a certification authority (CA) that is trusted by the parties involved, and used for typical public key cryptography operations. The CA responds to certificate requests

⁴ <http://www8.hp.com/uk/en/software-solutions/ponemon-cyber-security-report/>

only after verifying the identity of the applicant. (See Exhibit 3.)

However, if one link in that digital chain of authority is broken, the whole system is compromised. As attacks on CAs such as GlobalSign, Comodo, and DigiNotar have demonstrated, if the private issuer of the certificates is compromised, the entirety of the PKI goes with it. This represents a significant vulnerability in the structural design of PKI that is difficult to mitigate.

The structure and design of PKI can also create fundamental flaws. Billions of Secure Sockets Layer (SSL)-enabled websites and hosts exist on the Internet, each requiring unique SSL certificates with valid names and current digital certificates linked to a trusted CA. Yet, in many cases these hosts and sites have self-signed, revoked, and expired certificates; invalid digital signatures; potentially compromised keys from previous vulnerabilities; or broken or non-existent chains of trust with known CAs. Also, interoperability across CAs is limited, resulting in disparate communities of interest that are unable to communicate with each other. **Essentially, the beauty of the mathematical equation that makes PKI work is tarnished by the overly complex infrastructure that is ripe for human error and misconfiguration issues.**

In theory, certificates add a layer of security to digital processes, but they have proven to be far

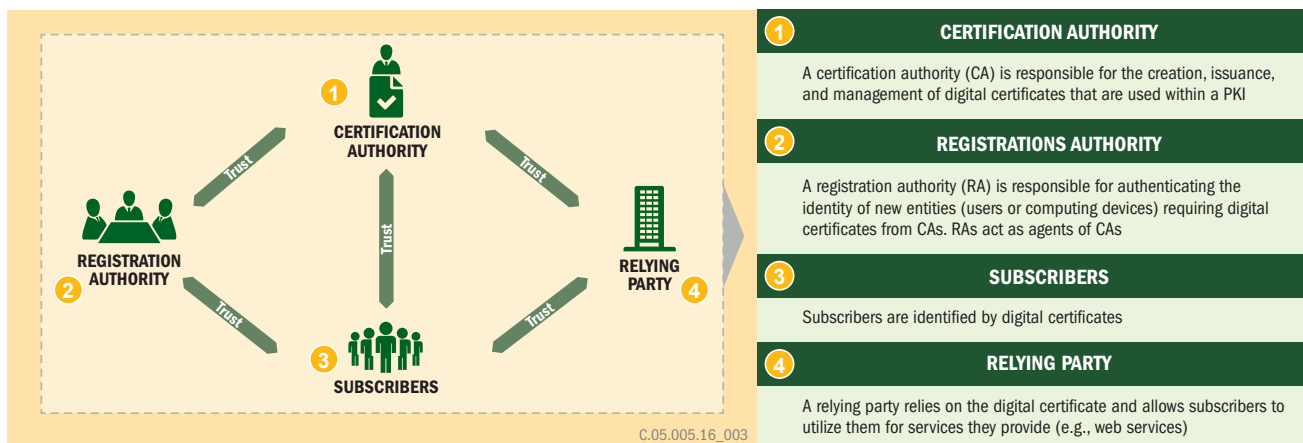
from failsafe, with multiple attacks reported across the globe. U.S.-based software group Comodo was the first organization to suffer the consequences. In 2011, the username and password assigned to a senior manager at the group were compromised and used to issue nine fraudulent digital certificates across seven domains, including the login domains of Yahoo, Skype, and Google.

This is indicative of a broader and concerning reality: Internet integrity simply does not work. When confronted with sophisticated cyber threats, systems need to be scalable and flexible. Where systems are neither, smart city integrity can be left vulnerable to attack.

Shoring up digital security is therefore a vital step as countries develop strategies to ascend into the ranks of the world's most innovative nations. **To this end, the systems, costs, and timescales associated with bringing smart cities to life must be conducive to the creation of the fast and secure solutions that GCC governments crave as their era of innovation dawns.**

It is here that the importance of blockchain rises to the fore: a technology that moves at the speed of innovation and has the power to **protect and enable** smart city development, **disrupt** digital transaction norms, and **incubate** the startup and accelerator ecosystem that is taking root.

Exhibit 3 | Components of Public Key Infrastructure (PKI)



Conventional PKI components rely on a digital chain of authority, but if one link in the chain is broken, the whole system is compromised.

POTENTIAL CHALLENGES FACING GOVERNMENTS WORLDWIDE	
Challenges	Benefits of Blockchain
There may be technical complexities, such as: <ul style="list-style-type: none"> • Insufficient measures to protect PKI • Complex digital chain of authority • Lack of technical knowhow and interoperability challenges. 	<ul style="list-style-type: none"> • Simple and efficient nature of technology removes layers of complexities while shoring up security. • Blockchain helps mitigate the risks associated with digital certificates/CAs.
Costs and timescales associated with current systems are inadequate and/or unsustainable.	<ul style="list-style-type: none"> • The direct costs of transactions are lower due to distribution across the network. • Speed and participation, not command and control, are defining features.
There may be unwillingness to share data.	<ul style="list-style-type: none"> • Blockchain technology removes the security concerns often used to justify unwillingness to reveal information, while encouraging the adoption of data-sharing incentives.
Outdated systems could leave transactions vulnerable to fraud.	<ul style="list-style-type: none"> • Blockchain reduces exposure to fraud.
Existing systems and capabilities could be inadequate to handle growing severity and frequency of cyberattacks and other risks associated with value exchanges.	<ul style="list-style-type: none"> • Transfer history is transparent, traceable, and practically unalterable. • Transaction settlement occurs in near real time, with no counterparty risk. • Tamper-proof lists enable secure value exchanges.
Inaction and poor planning can compromise performance.	<ul style="list-style-type: none"> • Simplicity of technology for the end user means smaller margin for error and requires minimal action, planning, and monitoring compared to existing systems.
Current systems are potentially unscalable, insecure, complex, and inflexible.	<ul style="list-style-type: none"> • Blockchain offers a more streamlined and effective way of enabling digital trust, allowing parties to transact directly with no intermediary required. • Blockchain facilitates web-scalable approaches, such as distributed and decentralized architectures.

Blockchain: Realizing the Data-Driven Vision

The value of blockchain technology is mirrored in the value of data.

Inside the digital economy, data should be treated as a currency—a fiat currency to be precise. A fiat currency is one that is recognized by government but not backed by a physical commodity. Much like the oil that lies beneath the Arabian Gulf, data is a hugely valuable and abundant asset, yet *unlike* the region’s slick natural resource, it remains vastly under-tapped. When collected, analyzed, and used effectively, data can enhance almost every aspect of daily life. Without it, there can be no progress.

Specifically, the value of data lies in the insight that can be derived—and in many cases, that value exceeds monetary worth. This is a reality that Google latched onto long ago. From the company’s inception, its services have been offered to users free of charge. Why? Because Google’s decision makers understand that the data it collects is far more valuable than any potential revenue from charging a fee to its users.

Similarly, GCC governments must now understand that **data is the currency that will drive smart city growth**. Standing in the way of this realization, however, is an unwillingness to share it. Understandably, closely guarded information is widely viewed as a competitive advantage, yet what organizations fail to realize is that refusal to divulge data deprives the region of exactly that. Only by creating a rich and shared pool of information can the GCC compete to earn its place at the top of the smart city chain.

Although there is a long way to go, Dubai is starting to respond to the challenge with the introduction of the Dubai Data Law in 2016. The new law requires individuals and organizations—both public and private—to make their data available, either for free or in exchange for data from other providers.

In the push to turn data to currency and maximize its value, **blockchain technology is indispensable. It can remove the security concerns often raised by organizations to justify their unwillingness to reveal information, while encouraging the adoption of data-sharing incentives and fostering a community-based ecosystem that can determine the value of data over time.**

A Work in Progress

Of course, although blockchains are rapidly becoming an integral component of data-driven visions, no technology is without its flaws. In the case of blockchains, high volatility may exist in the value of the native “currency,” and regulatory scrutiny can create challenges when connecting with fiat currency ecosystems. Meanwhile, anonymity of accounts and irreversibility of transfers can also lead to security implications.

However, as a technology still in its infancy, scope to mitigate these challenges is great, and in fact, many of the solutions already lie in the creation of appropriate skills, governance, knowhow, and infrastructure—several of which are explored below. But perhaps most important, in the campaign for safe and smart cities, the tangible blockchain benefits far outweigh the potential weaknesses.

To truly capitalize on these benefits, GCC governments must embrace this secure method of transacting and use it to drive comprehensive models that can mature innovation and effect digital economy change.

Blockchain: Disrupt Digital Transaction Systems

As the GCC countries strive to become leaders in the digital arena, ambitions must be accompanied by the creation of modern, secure, and trustworthy infrastructure that allows the digital economy to flourish. Here, technology is a key enabler, but it is no simple fix. To succeed, **governments need to implement web-scalable approaches such as distributed and decentralized “shared nothing” architectures that allow for exchange and processing of infinite data, generated by a multitude of sensors and machines.**

Ensuring that such technologies—and the related skills—are in place is a complex task that commands the attention of the region’s top decision makers.

It is here that the importance of blockchains is perhaps most evident. **The technology offers the GCC**

a compelling and innovative approach to securing the exchange of value inside the smart city, with potentially monumental implications across a diverse mix of industries.

Industries in Focus

Smart Healthcare

Healthcare is a core sector at the center of smart city development. For residents across the GCC—and indeed worldwide—their health is their biggest asset. It is also one of the most private areas in a person’s life, yet healthcare data breaches occur all too frequently. In just one of several global examples, the personal and medical information records of almost five million patients were compromised in an attack on the University of California, Los Angeles, hospital in July 2015.

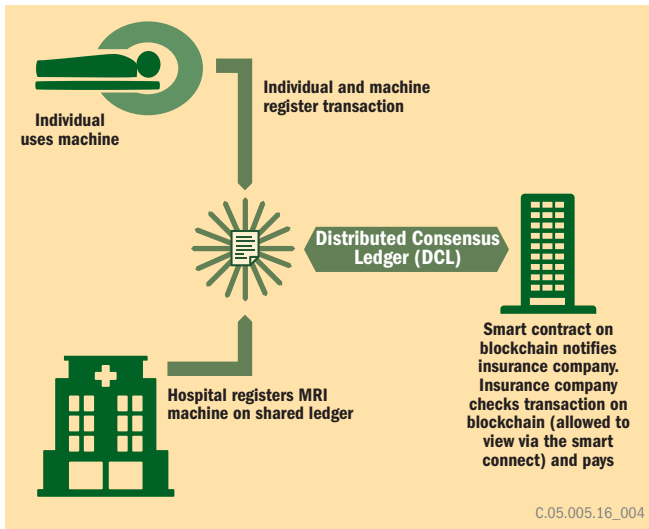
A blockchain can help prevent this kind of data breach scenario through the creation of trustworthy, multi-signature, and cryptography functions.

Using the technology, data can be hashed onto the blockchain and only accessed with signature approval from a predefined group of people—a combination of doctor, nurse, and patient, for instance. This kind of security is particularly pertinent to the issue of medical records. **Using blockchain, patient records can be created, shared, and accessed by multiple parties, without compromising data integrity or security.**

In addition to securing patients’ private medical records, blockchains tolerate conditional privacy. Often, **patients either authorize full access to their medical records, or no access at all. Through blockchain technology, patients can use their own signature, combined with that of a hospital, to unlock specific sets of data under different situations. This could include, for instance, sharing full personal health history when a patient’s heartrate drops below a specific number of beats per minute.** Such capabilities mean that patients can share potentially life-saving data while protecting their privacy needs.

Patient willingness to share data extends to research and development (R&D), too. For example, individuals

Exhibit 4 | Blockchain for Medical Smart Property



are often happy to contribute information from their quantified self-tracking devices or health and fitness apps, if they believe it will lead to medical advancements. A platform for this, however, has been largely absent. **Filling the gap, blockchain provides a standardized secure mechanism for aggregating health data into data commons, which are made available to researchers through a private key.**

Adding to their uses, blockchains can also be advantageous in the insurance and billing arena, with the technology creating the possibility for patients, insurance companies, and hospital billing departments to manage payments through a single platform and reduce redundancies across the industry. Here, the implications for medical insurance fraud are significant, too. **Blockchains improve the certainty of claims processing by ensuring that medical records have not been tampered with.** They can help prevent fraud by mining and validating any medical transaction between individuals, as well as machines, before replicating it through the network. As part of this process, the blockchain notifies the medical insurance provider, or the federal government in the case of federal health insurance, to then check the transaction by viewing the smart contract before making the payment on the claim. (See Exhibit 4.)

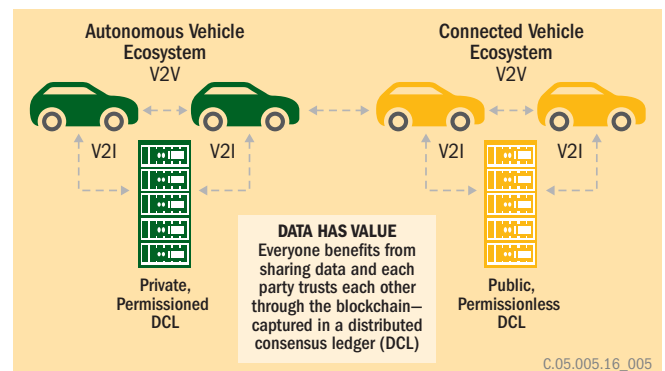
Smart Transport

Transportation is another key element of smart city development and falls more broadly into the increasingly personalized Internet of Things. The advent of vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) technologies means that cars are becoming an interactive component of a growing interconnected transportation grid. In addition to software and diagnostics that improve vehicle safety and performance, technological advances now allow vehicles to detect traffic patterns and report potholes, emissions, and fuel consumption.

These vehicle-to-everything (V2X) advancements take interactivity to the next level. **Smart connectivity is paving the way for an autonomous vehicle that drives better than we do, with much faster reaction times thanks to a series of network computers.** And it's not just about speed: where human behavior can be irrational, connected smart vehicles are designed to make consistently smart choices. The result is lower fuel consumption, shorter journey times, and a dramatic reduction in accidents.

However, with such connectivity comes vulnerability, in a world where threats to cybersecurity are greater than ever. **Blockchain technology can help mitigate these threats by providing a trusted and secure platform through which participants can transact, with data captured safely in a distributed consensus ledger**

Exhibit 5 | Blockchain for Smart Vehicle Connectivity



The autonomous and connected vehicles are likely to be made up of multiple, disparate device ecosystems with different ownership rights and information-sharing protocols (e.g., a Ford ecosystem in which Ford vehicles exchange V2V information with themselves and V2I with publicly owned or private infrastructure).

(DCL). These DCLs exist in both public and private forms. The former are “permissionless” ledgers. This means there are no restrictions on reading data—which still may be encrypted—or on submitting transactions for inclusion into the blockchain. In the cryptocurrency world, this is the approach employed by Bitcoin. By contrast, private DCLs are restricted, or “permissioned,” with access to data and transactions limited to a predefined list of entities. (See Exhibit 5.)

Smart Finance

Blockchains are disrupting the financial system by offering a direct, efficient, and secure transaction environment for the exchange of a full range of financial instruments from stocks, bonds, and cash, to wages, benefits, and airline miles. Also within the financial context, the technology facilitates the safe exchange of legal instruments such as identity proof, services such as compensation, and organizational value such as networks of service agreements.

While blockchains are most widely associated with Bitcoin, the technology has game-changing applications that can increase the performance of transactions, drive down costs, and eliminate the need for existing legacy systems such as financial clearing houses.

Most important, however, is the ability of blockchains to enhance the safety and security of the ever-growing number of digital transactions taking place across the region—a number that is set to rise even further as smart cities advance and mature.

While the digital economy is embraced by consumers and government leaders, cash in the GCC remains king and resistance to change persists in some areas—particularly where there has been a historical reliance on paper-based payments and technological capabilities are limited. Then, there are the “green field” challenges of shortfalls in infrastructure and talent, the existence of multiple stakeholders, and the introduction of new, untested technologies.

Smart Finance: Applications for GCC Government

The following examples provide just a small window into how blockchains can help GCC governments in their quest for smart financial system security.

Access to the Islamic Capital Market: Global Islamic banking assets held with commercial banks were estimated to have reached \$920 billion in 2015, with the GCC countries plus Indonesia, Turkey, and Malaysia accounting for 80 percent of that figure. This sum is indicative of the growing importance of Islamic banking and finance, with the Islamic capital market at the core. As part of broader efforts to build appropriate capital market frameworks, blockchain technology can play a key role in securing and facilitating transactions, and improving trusted and broad-based access for investors.

Smart Islamic Finance Loans: Using blockchain technology, an individual could apply for a loan from an Islamic bank by issuing a smart contract that disclosed his or her information, which would be mined, validated, and replicated through the network. The bank in question would then take the contract and transfer the funds accordingly. The smart contract would be used to track all transactions in order to show the loan was being used as promised, and the lender would be notified of all purchases. If the loan terms were violated, payments would immediately be ceased and secured, and property captured.

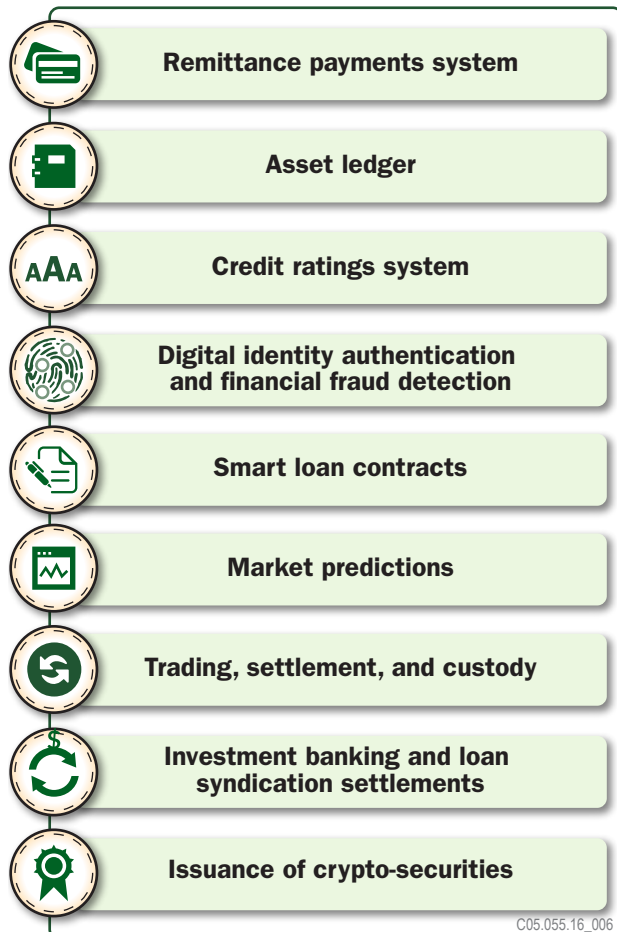
Managing Identity Theft: Identity theft relating to a range of financial payments is a major problem. It has been a serious concern ever since consumers and corporations started transacting online, but the issue is growing ever greater as more and more people turn to the Web for banking services, e-commerce and other online activities that require them to divulge personal and financial data. By linking transactions to a shared ledger, a blockchain can validate and track each exchange while monitoring, preventing, and reporting fraudulent activity.

Smart Grant Financing: Typically, when a student or researcher applies for funding, the lender offers a contract on the proviso that certain grades are achieved and other conditions met. With the use of blockchain technology, before funds are allocated the loan contract is mined, validated, and replicated through the network, with payments deferred if the predefined conditions are not met. With R&D and access to education as top priorities across the GCC, blockchains can support effective and appropriate provision of vital loans.

In this context, an advanced security model is needed to protect the smart city by leveraging sophisticated technologies on multiple levels, including security of networks, data, and applications, as well as access control.

An important step in shoring up the Gulf’s financial systems is the deployment of financial intelligence units (FIUs). Typically, an FIU is a national-level government organization that receives reports of suspicious transactions from financial institutions and other persons and entities. It analyzes them and disseminates the resulting actionable intelligence to domestic law enforcement and foreign FIUs. In turn, these bodies act on the information to disrupt money laundering, terrorist financing, and other illicit financial activity. In this context, blockchain can enable the FIU by providing increased transparency and visibility into potential vulnerabilities into the financial system.

Exhibit 6 | Opportunities for Blockchain Use in Smart Finance



Blockchain: Incubate a Startup Ecosystem

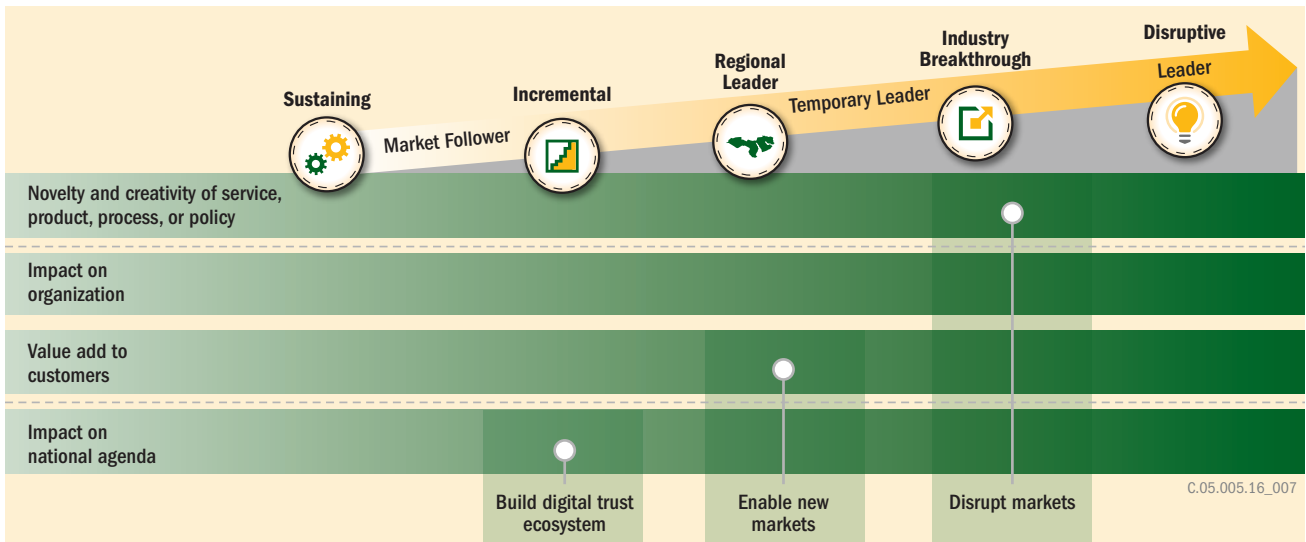
Incubating startup and accelerator ecosystems is integral to the GCC’s digital economy growth. Here, with the power to simplify processes such as registering a business, securing funding, and patenting ideas, blockchains once again have an important role to play.

The technology can enable individuals to make their data accessible to a number of preapproved entities involved in the network, such as business registration, patenting, and funding authorities, while also allowing data to be updated in real time. This reduces the need for duplication of information, facilitates application processes, and reduces the time and some of the costs associated with starting up and running a business.

Already, the GCC is tuned in to the benefits. The Global Blockchain Council established by the Dubai Museum of the Future Foundation sets out to encourage startup incubation and explore the technology’s potential impact on business and finance, as well as its role in facilitating transactions across sectors. The first pilot project will reportedly focus on Bitcoin exchange, BitOasis, which Dubai Multi-Commodities Centre (DMCC) will implement to secure flexidesk contracts, and registration processes using the blockchain ledger.

Meanwhile, initiatives and developments in other corners of the world point to applicability of international proportions. The introduction of the UK’s Government Digital Service and Digital Economy Unit underscores the importance of blockchain technology at the national level, while the European Parliament’s call for a resolution on distributed ledger technology and virtual currencies indicates that the debate is rising up international political agendas. The Russian Central Bank also has embraced the technology, as have the Australian and Korean stock exchanges, as well as startups and academic institutions such as the MIT Media Lab, which introduced a project for issuing official credentials on blockchain.

Exhibit 7 | Innovation Maturity Model Applied to Blockchain



Estonia serves as an interesting case in point. The country uses a distributed ledger technology called keyless signature infrastructure (KSI). KSI allows citizens to verify the integrity of their records on government databases and has enabled the government to streamline its services and launch new digital offerings, such as e-Business Register and e-Tax. In turn, these developments have reduced the administrative burden on both states and citizens.

Call to Action: Blockchain in the GCC

Blockchain technology can assist GCC governments and the private sector in **incubating a startup climate**. As the GCC seeks to nurture its startup landscape, blockchain technology can help eliminate some of the obstacles that stand in the way of entrepreneurial success by streamlining application and registration processes.

To enable new markets and disrupt existing ones, governments can begin by piloting distributed ledger projects. This will enable them to understand the true potential of blockchain technology and its real-life applications within the public sector. Such pilots can be coordinated in a similar way to clinical trials where implementation, reporting, and assessment

are concerned, to maximize uniformity and rigor. The outcome of these pilots can then be fed into the broader roadmap for blockchain rollout.⁵

The GCC can capitalize on blockchain technology to drive impact across the innovation spectrum. (See Exhibit 7.)

- 1. Build a digital trust ecosystem.** Digital economies begin with education and awareness raising. Already, Dubai has taken steps in this direction with announcements about the creation of The Global Blockchain Council and the development of the city’s aptly named Museum of the Future, a technology museum that explores emerging trends and inventions.

In addition to awareness-raising, the creation of digital trust relies on established national-level authentication and authorization mechanisms that are consistently applied. To this end, robust and powerful identity management tools are required, while measures to protect user privacy are also of paramount importance. Regional GCC national digital identity authorities, along with the national cyber authorities and ICT regulators should collaborate to integrate blockchain efforts into current infrastructure efforts. In addition,

⁵ “Distributed Ledger Technology: Beyond Blockchain,” A Report by the UK Government Chief Scientific Advisor

GCC governments must work with industry and academia to make sure that adequate standards are set and that they are reflected in regulatory and software code.

- 2. Disrupt markets.** Once understood and embraced, blockchain technology can be used to disrupt financial systems and a wide range of other industries by offering a direct, efficient, and secure transaction environment for the exchange of data and value in all its forms. In the UK, blockchain technology is being adopted by a number of government departments and, while outcomes will take time to emerge, there is good potential for similar efforts to be applied in the Gulf. The following disruptive projects in the UK⁶ are works in progress, yet highlight opportunities for the GCC to take forward:

- **Department for Work and Pensions:** New payment models will be implemented that will allow HM Treasury and the Department for Work and Pensions to improve policy and distribute welfare support in a more effective and efficient way. **GCC Opportunity:** Blockchain could be explored by regional finance and social affairs ministries to revamp the current tax, social welfare, and zakat programs in the region to provide more efficient assessment, collection and distribution of tax and zakat funds.
- **International aid:** Blockchain technologies will be used to better control the distribution of foreign aid, encourage better financial management, and help improve transparency. **GCC Opportunity:** With the burgeoning humanitarian needs surrounding the GCC borders, blockchain technologies could be used to ensure the donations and contributions of relief efforts are provided to those in need and adhere to international and domestic agreements through the use of smart contracts.

- **Enabling innovation and reducing market friction:** Blockchains will break down barriers and enable the creation of new information marketplaces. In turn, effective use of technological innovation will spur economic growth. **GCC Opportunity:** With the region looking to become a prominent international financial hub, blockchain offers the transparency, flexibility and trust needed to enable an efficient regulatory framework, legal jurisdiction, and business-friendly environment. By leveraging blockchain, GCC financial centers will be establishing international best practices that are similar to efforts by major financial centers across the world, including those in New York, London, Hong Kong, Tokyo, and Singapore.
- **Value-Added Tax (VAT):** The UK could play a key role in reducing the European Union's VAT shortfall through developing distributed ledger technologies. **GCC Opportunity:** GCC governments are finalizing their plans to introduce VAT, but regardless of the details, the rules will be very specific and nuanced based on goods and services per industry. To this end, businesses may be challenged to implement these rules and fully understand their impact. Blockchain offers opportunities to push these rules into the chain itself and, along with smart contracts, ease the burden of rolling out VAT in the region.

- 3. Enable new markets.** In addition to disrupting existing markets, blockchains can help cultivate new ones. With game-changing applications that increase transaction performance, reduce costs, and eliminate the need for legacy systems, opportunities emerge for the development of new concepts. For example:

⁶ "Distributed Ledger Technology: Beyond Blockchain," A Report by the UK Government Chief Scientific Advisor

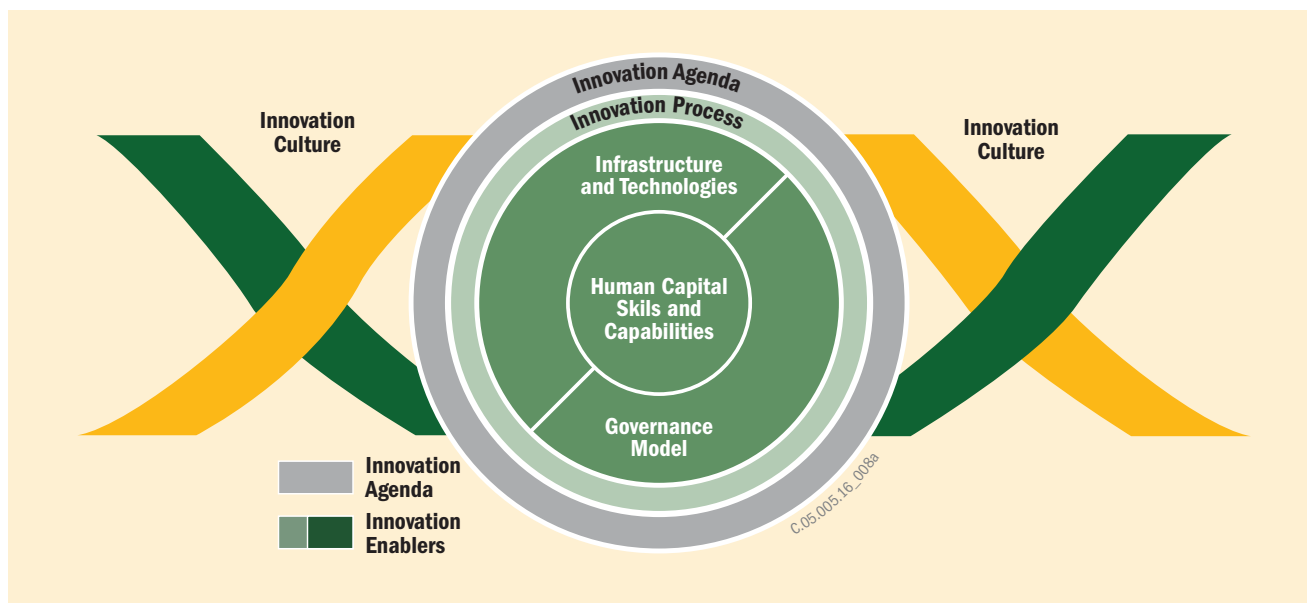
- *In the healthcare sector*, blockchains can redefine the way in which patient records are created, shared, and accessed, while also securing privacy and preventing payment fraud.
- *In the automotive industry*, blockchain technology is helping create a new market, with smart connectivity paving the way for an autonomous vehicle capable of driving better than humans can.

To enable new markets, governments can begin by piloting distributed ledger projects. This will enable them to understand the true potential of blockchain technology and its real-life applications within the public sector. Such pilots can be

coordinated in a similar way to clinical trials where implementation, reporting, and assessment are concerned, to maximize uniformity and rigor. The outcome of these pilots can be fed into the broader roadmap for blockchain rollout using an innovation framework.⁷ (See Exhibit 8.)

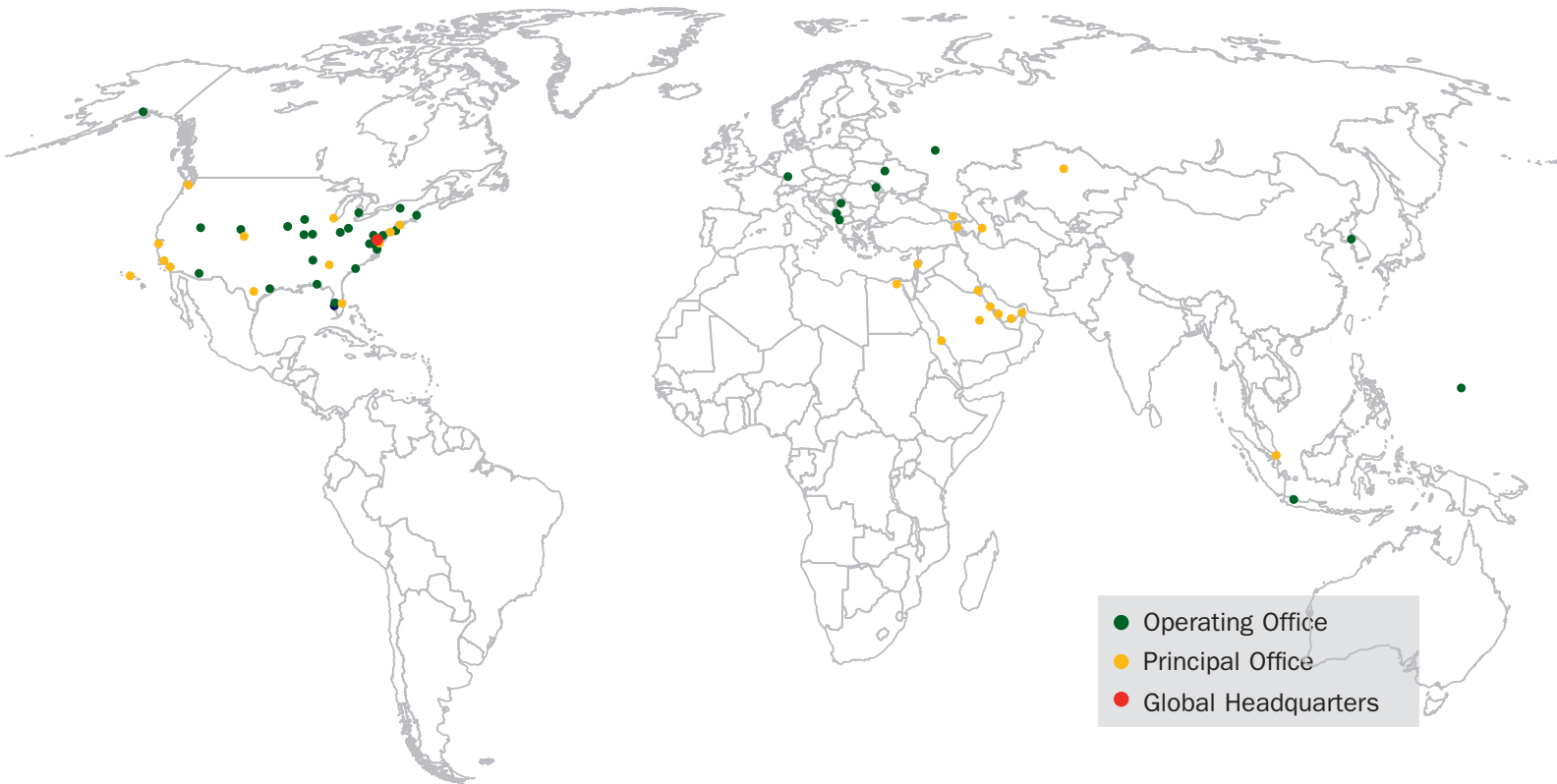
From startup incubation to financial transaction disruption, the potential applications of blockchain technology within the GCC’s overarching drive for innovation are manifold. To fully capitalize on this potential, the cultivation of holistic innovation enablers that span not just technologies and infrastructure but also governance, human capital, and capabilities is essential.

Exhibit 8 | Innovation Framework



⁷ “Distributed Ledger Technology: Beyond Blockchain,” A Report by the UK Government Chief Scientific Advisor

International Office Locations



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