Block23.me
Using Blockchain for making the world a healthier and better place to live in

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1. Executive Summary

An open Blockchain architecture has massive possibilities for delivering improvements in the health care industry worldwide, especially in countries such as the US where escalating costs are nearing 6% per year\(^1\) and 17%\(^2\) of the total US budget (over $3 Trillion annually).

One of the important recent efforts has focused on prevention and more effective treatment via ‘precision medicine’, a practice which aims to understand how a person’s genetics, environment, and lifestyle can determine the best approach to prevent or treat disease.

Projects such as the Precision Medicine Initiative\(^3\) look to get data driven insights from collecting and analyzing biological, environmental and behavioral data in order to drive strategy where it benefits most. For example, R&D in the biopharmaceutical sector which accounts for about 85% of the industry’s total R&D spending, would gain significantly from accessing large data pools that co-relate the onset and progress of disease to data about individuals.

Precision medicine is a revolutionary approach powered by the accumulation and analysis of massive amounts of health and biologic data\(^4\), with the ambitious goal of a ‘cancer moonshot’. However, notwithstanding initial advances, the practice is currently not in use for a variety of reasons, most of which can be traced back to the problems of large scale, expensive and centralized projects that are subject to a changing political climate.

Block23.me proposes a radical departure from current approaches by enabling individuals to easily store and have analyzed their health data on the Blockchain and, by doing so, removes major obstacles including:

- data silos that prevent unrestricted data sharing and exchange
- flawed data models from small data sets and human dependent analysis
- research ‘moats’ that keep insights and discoveries within an institute’s boundaries

In addition to data sharing and exchange, the analysis of petabyte level data volumes with hundreds of attributes working in conjunction is impossible without deep neural network (AI) technologies. As data scientists know, AI loves consuming data and, when applied to global data on the Blockchain, it can provide a continually self-learning infrastructure with real-time knowledge output. AI enables a system that is preventative and predictive, while Blockchain
incentivizes participation and removes the institutional dependencies that inherently create barriers.

Block23 aims to be the platform for medical researchers to access very large, well annotated, personalized data sets in order to discover ground breaking treatments and clinically useful biomarkers for some of the world’s costliest diseases by utilizing Blockchain and AI technologies that will deliver cost effective, precision medicine.

1.1 Problem overview

Data silos
Arguably, all problems on achieving the goals mentioned above start with siloed data that inhibit discoveries and exist for multiple reasons. Looking at some of the key issues reveals how entrenched data silos are in current medical practices and how profound the problem is:

- **Data management**: most hospitals and leading centers struggle to meaningfully organize the genetic and phenotypic data of their own patients in a fashion for informing clinical decision making.
- **Legal**: medical centers and practitioners are reluctant to share medical data, with liability issues a prime concern in case private medical records become public
- **Loss of competitive advantage**: medical data is often perceived as providing a competitive advantage for the institutions and researchers who generated them, presenting a dilemma of choosing between maintaining an individual advantage or enriching a common data set which is made more widely available to advance cancer research in a much more collaborative and therefore efficient way.⁵

As the director of the NIH All of Us project points out:

“The prototype aspect of our program is really about ending the notion of cohorts as we know them today but …. how do we get to the era of a universal cohort, with no silos and no cohorts?”⁶

Credibility
Winning the trust of communities mistreated in the past and of populations in various parts of the world that mistrust large institutions or government programs is another major obstacle.

As for example, the National Children’s Study launched in the US in 2000, was a government sponsored effort to understand the impact of children’s environments on their health and development. Fourteen years and $1.3 billion later, the effort was shut down, the victim of internal agency conflicts and problems with the design of the study.

Another complexity factor relates to politically changeable agendas:

“In and out is exactly what builds distrust. Or the idea that interest in a community is tied to a grant length…. many minority communities are uneasy with the idea of clinical research, a reality that NIH teams around the country acknowledge are trying to overcome”⁷
Scalability
The progress at the All of Us NIH project illustrate difficulties and the time and effort to achieve simple things such as registering people and collecting data:

“The hard part is scheduling future appointments and managing logistics. At most partner sites and at most of the mobile engagement unit’s exhibit stops, enrollees haven’t been able to simply fill out paperwork and walk into a room across the street to get their blood drawn.”

The experience at All of Us further bring to light the amount of manpower required for managing the project, bringing into serious question how it can reach its goals to collect 1 million patient records over the next 3 years:

“Right now I don’t have enough genetic counselors in the country to be able to properly, responsibly get that information to people in the study... that’s one of the big workforce problems we have.”

Security
Placing medical records and patient data onto a centralized database automatically implies vulnerability, a prime consideration for any large scale project. As Eric Dishman reports, the more data is collected from people, the more it becomes a target for hackers:

“Certainly privacy and trust is huge for us and we developed a set of principles with industry, with the website, with cybersecurity groups at the White House… we will be a huge target, and it’s one of the things I lose sleep about…”

According to the Ponemon Institute, breaches and identity theft on medical data are rising with criminal attacks up by 125 percent since 2010. The study found that 91 percent of health care organizations have experienced at least one data breach, costing more than $2 million on average per organization. The American Action Forum estimated that medical breaches have cost the U.S. health care system more than $50 billion since 2009.

Medical records are extremely valuable to thieves, with such data sold for an average of $363 per record, which is much higher than for credit card data. Additionally, whereas bank cards can be canceled for limiting damage, stolen medical data cannot be so easily recovered.

1.2 Effects on stakeholders
People
The distrust factor
“People are afraid of being experimented on,” said Dr. Robert Winn, the director of the University of Illinois Cancer Center and a principal investigator on the All of Us project.
Researchers know it won’t be easy to find thousands of people who have little reason to let the government sequence their DNA.

In a recent study commissioned by Research!America, 50 percent of African-Americans surveyed cited “lack of trust” as a barrier to participating in clinical trials and substantially higher than levels of distrust among whites. Further, many minority communities are uneasy with the idea of clinical research and the introduction of “we’re with the federal government, we’d like to sequence your genome, we’d like your Social Security number” is not necessarily a welcome one.

Patients

Making informed decisions
Understanding preventative measures and how to improve their quality of life requires direct access to research, analysis and health records that can be shared with the health care community. One of the knock off effect of information silos is that patients themselves don’t have immediate access to analysis and treatment records for sharing with professionals that provide useful prognosis and treatment information.

Researchers

Ongoing data collection
Researchers who typically depend on grant based studies are unable to have access to ongoing patient data outside the project time frames. Missing data on patient quality of life and treatment outcomes over time makes a significant difference in the accuracy of analysis and resulting conclusions.

Population limitations
Studies have 2 serious limitations, the first being the size and location of populations that participate in the study and secondly the focus on patients rather than on both patients and healthy individuals.

Whereas the former limitation is mainly a function of cost and regulations that result in most studies being conducted in Asia, the second one is the result of a treatment based approach rather than understanding the underlying causes of a disease.

Cost of research
Centralized initiatives are expensive: the All of Us project has a budget in excess of $200M and requires ongoing Congressional approval to approve funding over multiple years.

Technologies such as sequencing large amounts of DNA are expensive to carry out, although the cost of sequencing has decreased dramatically over the past decade and will continue to do so. Additionally, drugs that are developed to target a person’s genetic or molecular characteristics are surprisingly expensive. Reimbursement from third-party payers (such as private insurance companies) for these targeted drugs has become a major issue.
Health care practitioners

Applying precision medicine

If precision medicine approaches are to become part of routine healthcare, doctors and other healthcare providers will need to know more about molecular genetics and biochemistry. They will increasingly find themselves needing to interpret the results of genetic tests, understand how that information is relevant to treatment or prevention approaches, and convey this knowledge to patients.

Referring to the All of Us project, Nigel Paneth, the epidemiologist at Michigan State University, said the project appears to be insufficiently funded:

“If you do the math, there’s only a few hundred dollars for each person enrolled, and that will have to cover the lab tests, getting informed consent and other expenses,” he said. “It is likely that all that will be covered is clinical data already collected. There’s just enough money to only transfer the data.”

1.3 A solution: personal lockboxes

Personal Medical Lockboxes (PMXs) provides a solution for collecting, analyzing and sharing medical data and further gives people ownership of their health data. Since sharing data is in the hands of the data owner, cross-border and privacy regulations no longer apply. People can decide to share part or all of their data with an external party based on their interests and circumstances.

Utilizing a Blockchain wallet app, each individual’s medical history, profile and lifestyle patterns can be accumulated in a continuously-updated electronic “strongbox, under the exclusive control of the individual. Importantly, data can be easily connected to the lockbox from a variety of sources such as demographics and personal profiles from social media sites, bio data from wearables and apps, electronic health records, genome scans and more. We have developed a simple, structured health ‘survey’ which is a useful way to deposit individual data so that it might be readily aggregated and compared with other members of our Network.

Medical R&D and health care industry participants could offer crypto tokens in exchange for limited views into the Lockbox, thereby incentivizing people to place as much of their health data on their PMXs. The more people expose their data to a global market, the more value they receive and the more AI agents are able to uncover unseen relationships that contribute to disease. Additionally, individuals will also be able to ‘volunteer’ their data for socially beneficial studies which they feel may benefit mankind. This altruism model has its rewards in the generation of collective insights into the biology of cancer that will benefit future generations of cancer sufferers.

Each person would maintain control over their data within the secure Lockbox using their personal digital devices. Because their data is decentralized and of high value, people automatically gain a degree of power in their interactions with the health care industry and stand to benefit from better opportunities to select a program that suits their needs. This level
of control and value exchange would give people a sense of entitlement and a sense of partnership instead of the disenfranchisement commonly felt towards the medical industry.

With insights obtained to guide research and develop treatments, researchers could access a global registry with a new data model for discoveries and new prevention methods. Data can be shared across different ecosystems (e.g. medical practitioners + fitness centers + nutritionists), or with individual participants on a global scale ecosystem. The more data collected from more sources all over the world the more predictive the models become. For example, air particle data in China might be correlated to a high rate of lung cancer with quantifiable costs to populations in China.

1.4 Mission statement

“Our goal is to become a global registry and data model for achieving medical breakthroughs in cancer prevention and treatment by entitling people to become the driving force in a more effective health care system”.

1.5 Key objectives and goals

With the valuable crypto data obtained from PMXs, stakeholders from patients to industry, join the Block23 platform.
Block23 goals is to enable breakthroughs in cancer treatment by:

**Developing precision medicine in the area of cancer research.**
Become the agent for bringing precision medicine to all areas of health and healthcare on a global scale. In order to achieve this goal, Block23 will provide an app for people to connect their data to the blockchain with crypto tokens that will be used to order genetic scans and other cutting edge tests from a world-wide partner network.

**Providing researchers with AI tools that data mine, analyze and share large sets of medical data.**
Researchers can access a registry of data collected all over the world and from communities that have unique attributes as well as a data model that uses deep neural networks that continuously learns and adapts to new data sets, giving the capability to study a large range of diseases, predicting disease risk, how diseases occur, and finding improved diagnosis and treatment strategies.

**Building a trust partnership of people, scientists and institutions**
Provide the opportunity for millions of people to contribute to the advancement of scientific research while protecting research participants, patients' privacy and the confidentiality of their data and bringing them together with scientists in a wide range of specialties, as well as universities, research Institutes, pharmaceutical and biotechnology companies, and others participants.
2. Technology

There is a ‘divide’ between genotype (genome sequence of an individual) and phenotype (actual physical characteristics such as age, race, weight) which prevents us from associating genetic data and disease. This is promoted by a current false idea that sequencing the human genome of a relatively small number of cancer patients will provide an answer to ‘everything’.

Deep Learning, commonly known as a form of AI, is able to bridge the genotype-phenotype divide by aggregating an exponentially growing amount of data for analysis of the complex relationships and biological processes between the two.

Since most phenotypes are influenced by both a person’s genotype and by the unique circumstances in which a person has lived, including everything that happens to them over their lifetime, the nature of how Deep Learning works enables a continuous learning and discovery of variables that influence health and the onset of disease.

The need for Deep Learning vs. human analysis is further highlighted by the amounts and types of personal data that are made available in our evolving world. Electronic health records, live streamed data from IoT (Internet of Things) devices (wearables, health apps, tracking sensors), social media, cell phone GPS signals and more are generating a deluge of data.

*Data is growing faster than ever before and by the year 2020, about 1.7 megabytes of new information will be created every second for every human being on the planet.17*

The only way to get insights out of potentially very valuable data that individuals are continuously generating is through machine learning technologies. Ultimately, going beyond text, speech and image recognition, medicine represents the next frontier for Deep Learning.

2.1 Deep Learning platform

**Machine Learning**

Block23 has developed machine learning algorithms used to train data with the purpose of uncovering underlying patterns, build models, and make predictions. This was recently done at a study at Oxford University’s cancer R&D department with over 20,000 patient records, including pathology results, genotype analysis, clinical trial tests and patient history data (see case study).
Block23’s Deep Learning was able to identify associations between the structured data in the EHR (history of the patient, history of illness, treatments regimes, medications and lab results) and genomic data, deviations from the standard values from the reference knowledge base, and to further investigate disease comorbidities, patient stratification, drug interactions and clinical outcomes.

The resulting integration and analysis of electronic health records, fine-grained longitudinal phenotypic profiles, biobanks and genetic data, together with systems biology approaches was found to have a significant potential for delivering on the concept of precision medicine.

Block23’s Deep Learning looks for mutations that correlate with disease and how it develops over time. Here below, a Block23 analysis has learned from thousands of patient biomedical data which genetic markers are contributing to high-low patient survival times.

Data handling
Even data within the walls of a developed health care system, information silos typically manifest themselves in the form of multiple patient databases such as pathology results, genotype analysis, clinical trial tests and patient history data. Most importantly, those databases are typically in a non-standardized format that cannot be aggregated for machine learning algorithms to be applied.

In addition, the profound change brought out by the use of the internet and connected devices makes possible new ways to collect data on people’s health - machine to machine. Making genotype, phenotype and machine data usable by Deep Learning algorithms provides more ways to identify patterns that contribute to health maintenance and disease prevention. However, making data usable means getting the right data in the right format and it is one of the major hurdles to overcome in Deep Learning. The right format for Deep Learning is generally a tensor, or a multi-dimensional array. So data pipelines built for Deep Learning will
generally convert all data into vectors and tensors that linear algebra operations can be applied to.

When data is presented in various formats, it requires to be normalized, standardized and cleansed. Block23’s machine-learning ETL engine can perform data preprocessing tasks by collecting and correctly formatting data when collecting it from sources such as:

- Wearable devices: via API’s to devices such as Fitbit, Samsung Gear, Apple Watch
- EHR and bio medical file: by extracting and recognizing meta data fields that are mapped to a structured repository
- Social media sites: via API’s to sites such as Facebook, Twitter, Google +
- Client app: a mobile app for entering additional personal data

**Researcher tools**

Deep learning is not a black-box and even though it produces outstanding results, it is not enough to simply produce good outcomes. It is crucial to change the ‘black box’ into the ‘white box’ to provide logical reasoning just as clinicians do for medical treatments:

*One of the most widely used approaches is interpretation through visualizing a trained deep learning model….to visualize the corresponding motifs with heat maps or sequence logos…a mutation map, which shows how much each mutation alters the binding score, and the input sequence logo, where the height of each base is scaled as the maximum decrease of binding score among all possible mutations.*

Block23’s provides visualization tools and maps that allow researchers to do real time, multi-variant analysis and ‘what-if’ queries on large data volumes.
2.2 Blockchain platform

Decentralizing personal data
The current model is a centralized server where everyone who wants to connect with the server can send a query to get the required information. The problems with this approach is that everything is dependent on a centralized server network, vulnerable to attacks. Further, as previously noted, separate servers and databases store patient information, creating data silos.

On a Blockchain architecture, there is no longer one central server but hundreds or more distributed and decentralized peers (nodes), operating as a peer-to-peer network.

Blockchain does not just store data in a distributed and encrypted form, but it does it on a sequential chain in which each block contains a cryptographic hash of the block before it in the chain. This links the blocks and creates a de-centralised transaction ledger.

The Blockchain ledger can be made visible or public by the entity (person or organization) who has uploaded their data to a Blockchain address, thereby providing a transparent view into the historical sequence of facts and events, or it can be permissioned for privacy reasons.

Whether public or private, the ledger allows the stored data to be verified as consistent, and because it is decentralised it provides resistance to external attacks and malicious actors within the system.

Smart Contracts for information sharing
Ethereum is an open-source, public, Blockchain-based distributed computing platform featuring smart contract (scripting) functionality, which facilitates online contractual agreements, for example sharing of information on a distributed ledger that contains personal records of a patient.

For each person who is participating on Block23, the personal account is created on a Smart Contract.
This account contains the following information:

- the individual’s profile data items (encrypted and available for person only);
- the shareable Profile Data Records (encrypted and available for Block23 Profile Data Exchange Service);
- the individual’s sharing options for the profile data and records.

The individual can configure Profile Data Records options on the Block23 app.

There are the following Sharing Options can be set for each level of the Profile Data hierarchy:
  a) Public
  b) Private
  c) Shareable with a permissioned 3rd party

Smart contracts are designed by Block23 to give individuals and patients the means to upload their data to their own Blockchain address and set up sharing options with parties in the Block23 network, such a drug research companies, scientists, hospitals, doctors and any other peer in the network.
3. A New Deal for Health Care

As noted, Block23’s goal is the delivery of precision medicine by the accumulation and analysis of massive amounts of health and biologic data\(^1\). Block23 will accomplish that goal by enabling individuals to easily store and have analyzed their health data on the Blockchain and, by doing so, will remove major obstacles that surface from a centralized approach.

Incentivizing people themselves to place their data on the Blockchain is a critical step and will be accomplished by means of giving to subscribers free crypto tokens on their app wallets (see section 4) that will be used to order genetic sequencing and motivate patents and individuals to provide wide range of health data such as electronic medical record (EMR), wearable health check data, lifestyle data and real time information on the course of their disease for those individuals with cancer, world-wide. The data has high value to the stakeholders such Pharma, precision medicine players, and individuals world-wide. The data has high value to the stakeholders such Pharma, precision medicine players, and individuals.

Therefore, people will have a high degree of motivation to download the Block23 app and add their data in order to receive health care services, including genomic scans.

3.1 How data gets onto the Blockchain

**Personal data**
For individuals, getting started happens quickly and without any complicated steps for transferring data from all types of data sources to a Blockchain account.

As a first step, people receive an app and crypto wallet that connects to various data sources including 3rd party devices and apps. The types of data that get uploaded include:

- Personal profile and demographic data
- Medical records
- Health apps and wearables
- Location data
• Survey forms

When a person downloads the Block23 app, a Blockchain address is automatically set up with 2 way authentication access. Data is automatically uploaded via API’s from 3rd party apps and from health records that may require Block23 machine learning algorithms to correctly re-format the data (see 2.1 ‘Data Handling’).

Every new registered person will be rewarded by 2000 PMX token ($250) for free Whole Exome sequencing (WES). WES is the most valuable genomic data for cancer research, diagnosis and treatment. Block23 use the highest industry standard to select ad partner with WES sequencing labs to perform the test.

Block23 plans to offer free WES test to 50,000 cancer patients and 50,000 normal individuals with the budget of $25m. Plus to collect other 50,000 PMXs without genomic data, 150,000 PMXs in total will be created within 2 years.

In addition to the above the following means are deployed to reach and motivate data collection:

• Collaborating with patient associations, precision medicine companies, oncology societies, clinics, Health apps and wearable’s provider to promote Block23 program.
• Motivate people to upload genomic sequencing information plus other health data with regular follow up data. In return, people will be rewarded by more PMX tokens based on the grade of dataset (see scoring 3.2).
• Referral and review (rating) mechanism for all people and partners in Block23 community to create more personal health data lockboxes and improve the quality of the data.

Research and health care professional data
Connecting to Block23 via a secure web account, researchers and scientist can create their own Blockchain accounts and upload their data to Block23’s registry. Utilizing Block23’s AI agents provides the means to discover insight, create what-if assumptions and their own theoretical models for use in their own research.

Overtime, the registry becomes the central point for reliable and quantifiable associations on genotype and phenotype risks to cancer disease and further, increase the accuracy of predicting related risk factors.

Likewise, health care professionals such as community oncologists can set up a Blockchain account for each patient and upload data to receive the right information on diagnostic tests, molecular genetic tests and treatments, thereby providing patients with the same level of evidence based care that specialists at research hospitals are capable of giving.
3.2 Scoring data and health risks

Scoring data quality

Personal health data lockboxes will be measured by the 3 dimensions below:

1. **Data quality**: data source; data certification; copy or original; data cleanliness.
2. **Data richness**: number of data types; Genomic and other omics data; EMR and more.
3. **Data period and frequency**: length of data collection, time periods, higher follow up and monitoring frequency.

Each dimension will be given a different weight. In the end, PMXs will be classified into Grade 1, Grade 2, Grade 3, Grade 4 and Grade 5. The higher the grade the more a person gets PMXs as a token reward.

Scoring health risks

The goal is to provide the Block23 app to the widest possible audience. Currently Block23 has, via partners, access to over 10 million individuals who will be interested to put their health records on the Blockchain. Further, Block23 plans to offer free genomic scans to over 100,000 people which is significantly more than the hundreds of patient scans and limited phenotype data typically used in research studies.

Block23 will use the Oxford Polygenic Risk Scoring system which was developed over years of intensive cancer research by leading scientists for representing risk in a standardized and meaningful way. Polygenic risk scores comprising established susceptibility variants have shown to be informative classifiers for several complex diseases and for predicting and understanding genetic architectures. Polygenic scores have substantially higher predictive performance than the genome-wide ‘statistically significant’ scoring methods used because it is able to show how a genetic trait is affected by a large number of phenotype variations.

Based on the breadth and depth of data that will be available on Block23, AI and Deep Learning algorithms are self-trained to detect the patterns that lead to disease and will represent risk to stakeholders at level of reliability currently not available.

3.3 How data is shared

A Personal Medical Lockbox (PMX) is implemented using Ethereum Smart Contracts technology. PMX will store the following hierarchically organized Profile Data on the Ethereum Blockchain:

The individual Personal Data (PMX) is set up on the Block23 app by connecting to Facebook or Twitter to extract personal data from his social profile (a data form is available as an alternative). The Data Profile Records get automatically collected by app and bio and health data are collected over time. All Data Records are encrypted with an individual encryption key using a symmetric encryption algorithm e.g. AES and placed on the Ethereum Blockchain.

If a Person wants to participate in sharing his PMX, there are the following Sharing Options that can set be for each level of the Profile Data hierarchy:
A) Public
B) Private
C) Shareable for a token

For example, the following Sharing Options can be set up:
1.1 - Public
1.2 - Public
1.3 - Public
1.4 - Private
1.5 - Private
2 - Shareable for 1,000 PMX tokens
3 - Shareable for 1,800 PMX
4.1 - Shareable for 3,200 PMX
4.2 - Private

Shareable for an amount of PMX tokens means that the Person Profile Data Records can be shared for X amount of PMX for a period of 1 month.

The Sharing Options data is also saved to the Ethereum Blockchain and can be obtained by any 3rd party using a public Smart Contract request.

The data items which are public get saved as clear text on the Ethereum Blockchain and can be requested by anyone using a Smart Contract request. The data items which are Shareable for tokens get encrypted with a private key of the asymmetric encryption algorithm. The public key which allows to decrypt shareable data items and grant access to them is submitted to the Block23 Individual Profile Data Exchange Service together with Sharing Options data.

The Block23 Individual Profile Data Exchange service builds a full directory of people participating in this Profile Data Sharing Program along with their Risk Score, allowing Research units and Health care providers to find relevant people to purchase Individual Profile Data from.

3.4   How Blockchain for Health Care works

Blockchain Health will enable a ledger of transactions to be shared across a network of participants (health care providers, research units, people). When a new transaction occurs (for example, a token is issued, redeemed, or exchanged), it gets signed with the digital signature of the party executing that transaction.

The transactions are grouped into blocks (for example, every 1 minute) and distributed across the network, updating every ledger at once. New transaction blocks are validated and linked to older blocks, creating a strong, secure, and verifiable record of all transactions, without the need for intermediaries or centralized databases.

When setting up, a user (e.g. research scientist, individual, oncologist) can:
• Search and define a population based on a large number of parameters (demographics, genotype, phenotype, Health Risk score etc.) and then send tokens to individuals that, when accepted, will provide limited access to the individuals’ Personal Data Profiles.

• Upload anonymized data sets to be parsed through Deep Learning agents for analysis and comparison against other population groups on Block23 and pay for this service in the form of tokens

• Add and share data to the Block23 registry for enriching the master data and receive payment in tokens

• Share analysis results and research findings with the Block23 health care community of data scientists, researchers and physicians and receive tokens in exchange

In the role of primary broker, Block23 executes any exchange trades on behalf of the health care participants to ensure liquidity and errors. The result of the token mechanism is to exchange value in return for contributions in the form of research, expertise, services and data uploads.
4. Tokens

4.1 Why a PMX token?

Health care providers and pharma who have reward programs operate them in strict isolation from market activities by other providers. This control comes with a crucial limitation, since the provider can only maintain a *partial view* (or incomplete profile) of each person, based on the interactions each person has within each provider’s own “walled garden”.

The provider reward currency is entirely dependent on each provider’s revocable promise. It has exchange value only within their “walled gardens” and that can evaporate or be devalued at any time when the rules change.

**A need for universal rewards**

From the perspective of the loyalty member, there is a demand to pool one’s loyalty currency into a single account with greater buying power and flexibility. A new type of rewards system would enable this.

A universal, exchangeable reward point such as a crypto token provides an incentive to the person to ensure all their purchasing behaviors are recorded, even with providers they patronize infrequently, because it would result in a greater cumulative payback – more rewards from more providers. Since the tokens are universal, people would redeem them when ready at a provider of their choosing, for items or services of real value to them.

The consolidated personal profile would potentially capture a more complete picture of their habits, engagements and preferences, enabling providers to compete to provide relevant offers. Additionally, reward redemption behaviors would add insights and precision to this process.

**The PMX token is a universal token for all health care providers**

PMX has been specifically designed by Block23 experts to handle most of all logical ways that providers issue rewards and how people can redeem them.

People can see provider offers and rewards expressed in PMX and have the ability to transact in PMX across providers. Because the platform enables a decentralized ‘coalition’ of providers, rewards of various types and conditions are linked together, allowing transactions to be cleared seamlessly.
4.2 Token economics

The 3 principal participants in the PMX ecosystem:

• People who give limited access to their data in exchange for PMX tokens, then use PMX to purchase goods and services

• Research units, pharma and health care providers who buy PMX tokens with Ether and pay people for data access, then receive tokens from people making purchases and give tokens as a Health reward

• 3rd party developers who create apps that use the Block23 platform and Blockchain for managing PMX exchanges between people and health care providers

How Health care providers obtain Tokens

There are the following sources for Health care providers to get PMX tokens

1. PMX can be purchased from exchanges using Ether

2. PMX can be purchased from third parties include application developers who developed apps that are holding PMX they wish to exchange for other crypto currencies

3. PMX can be received from people in exchange for purchases (e.g. Provider offers People a special price and sells goods or services in exchange for PMX)

Using Tokens to purchase people data

The Brand, Provider or any other party willing to obtain Individual Profile Data can use the Block23 Individual Profile Data Exchange Service via a Block23 app to find relevant people by their Profile Data included in the sharing program.

The response to this request includes the following data
Person 1 ID
Publicly Available Profile Data Items
Data Item 1, Value
Data Item 2, Value
Etc.
List of Data Items available for Reward
Data Item 1, Reward Amount R1
Data Item 2, Reward Amount R2
Etc
Person 2 ID
Health Score
Etc.

The Provider analyzes the Profile Data Response and make a decision what data items should be purchased. E.g. He can set up the following Purchasing Conditions on his Purchase Data UI:
Purchase 1.3 if Reward Amount <= 50 PMX
Purchase 1.4 if Reward Amount <= 100 PMX
Purchase 2 if Reward Amount <= 150 PMX
Etc.
When Rules are set up, the following process is executed:

1. The Provider makes a Purchase request on the Block23 Individual via the Profile Data Exchange service;
2. The Block23 Individual Profile Data Exchange service builds a list of token transfer transactions for all the token payments the Provider needs to do for each of the selected people;
3. The Provider approves all the token transfer transactions and they get executed on the Blockchain;
4. After token transfer transaction is executed, the Block23 Individual Profile Data Exchange service grants the Provider access to the purchased shared data of this People by assigning decryption key for these Data Items to the Provider account.

**How Third party application developers use PMX**

Third party application developers can freely develop their own dapps using the Block23 platform which may involve the following options for exchanging tokens:

1. The application can allow people to earn PMX for different activities
2. The application can allow people to spend PMX to get some services provided by the application
3. The application can allow people both earn PMX via Data Sharing and spend PMX for different kind of activities/services provided by the application.

This kind of application can easily be integrated with the token exchange services because they are built on the common Ethereum Smart Contract platform. In case the application needs to do a token transaction it can easily use its own crypto wallet to transfer or receive tokens from any other party.

**Example scenario of how Health care providers interact with People**

1. Registering Health care providers
When a Provider is registered on the program a new Provider token account gets created on the Ethereum Smart Contract. The new account gets initial balance of 0 PMX.

Provider 1 Balance = 0 PMX
Provider 2 Balance = 0 PMX

2. Purchasing initial tokens
To get an initial token amount of PMX, health care providers can purchase PMX using ETH or fiat currencies based on the exchange rate at the time e.g. 1 ETH = 5,400 PMX (subject to change)

Provider 1 sells 1 ETH to buy PMX
Provider 2 sells 2 ETH to buy PMX
Provider 1 balance = 5,400 PMX
Provider 2 balance = 10,800 PMX
3. People Registration
The people gets registered on Block23 and his PMX is created on the Blockchain. The people gets an PMX account created on the Smart Contract with a starting balance of 0 PMX and fills in his personal/demographics data for the profile. He can also connect his Facebook or Twitter account so that related Profile Data Items get filled in automatically (number of friends, likes, favorite research units, products etc). All Profile Data gets encrypted and saved into Smart Contract data storage.

4. Settings up Sharing Options
The people PMX views his Profile and configures Sharing Options: what Data Items are Private, Public and what can be Shareable. For the Shareable Data Items People sets up a price for sharing in tokens. e.g. price of 250 PMX indicates the data item can be shared for the reward of 250 PMX for a 1 month period. Sharing Options and decryption keys are transferred to the Block23 Individual Profile Data Exchange service using an API call e.g. People sets ‘Full Profile Sharing’ is for 250 PMX but ‘Brand Preferences Only Sharing’ is for 100 PMX.

5. Evaluating Data and assigning a Health Engagement Score
Block23 Individual Profile Data Exchange service makes an evaluation of available People data and assigns a Health Engagement Score for the People data currently available. The score value is available for the Health care providers and Research units to help make decisions on purchasing meaningful profile data from People.

6. Receiving Rewards from Health care providers
If a Provider decides to purchase Profile Data Items from the people, the Block23 Individual Profile Data Exchange service settles up the deal making data available for the Provider and ensuring PMX transfer to the People token account from Provider token account (e.g. Provider 1 purchases full People Profile for 250 PMX and Provider 2 purchases Brand Preferences for 100 PMX).

   People Balance = 350 PMX
   Provider 1 Balance = 120 PMX
   Provider 2 Balance = 70 PMX

7. Spending tokens for Provider Rewards
The participating Health care providers are able to offer rewards to People in PMX e.g. Provider1 offers a Smartphone Case for 100 PMX. If the People has sufficient PMX he can purchase a Smartphone Case from Provider 1 and pay Provider1 100 tokens. This increases the Provider1 token account balance for purchasing of more People Profile Data Items.

   People Balance = 250 PMX
   Provider 1 Balance = 220 PMX
   Provider 2 Balance = 70 PMX
4.3  **Token sale event**

**IP and SMI contribution**
Block23 will receive an IP transfer from Sharemyinsight and Cyscom Ltd., with royalty free and unlimited usage of technology and products, valued at $20M USD. The IP and products include the AI platform, analytical interfaces, applications, utilities and more, all of which are described in section 3 and on the SMI site (http://www.sharemyinsight.com). Additional IP and products will be made available on the same royalty free terms and conditions.

Expressed over 3 years, the SMI founders estimate the IP contribution to be $150M to $200M USD, based on IP evaluation and discounted future sales of PLM.

**Why a token sale?**
Although Block23 will receive from SMI working technology and products in the retail sector, the Health reward transaction platform requires developers, marketing team, account managers, legal advisors, designers and other specialized resources – all of which requires additional funding to the SMI contribution.

In contrast to the traditional venture capital route for raising capital which benefits only a few participants, offering a token sale enables a community of retail health care providers, research units and people to participate in Block23’s growth and success story.

4.4  **Security Token Launch**

For the Block23 token launch, 2.50 billion Block23 tokens (PMX) will be created and registered on the Ethereum Blockchain, of which 1.75 Billion will be offered for purchase.

A purchase limit per person will be in effect to provide equal access to all investors during the first twenty-four (24) hours of the token sale. The purchase limit will be based on the number of tokens (as defined below) divided by the total number of investors who have completed registration. After the first twenty-four (24) hours of the token sale, the purchase Limit will be removed.

Prior to the start of sale period, the smart contract system will release a pre-allocated amount of 600 million PMX to BlockFilm, of which:

- 400 M will be provided to as compensation for employees, contractors, and other activities connected to deployment and platform development.
- 200 M will be allocated as a growth fund to incentivize contributors and audiences to buy BFT tokens

A separate amount of 1.75 Billion PMX will be allocated for sale to registered buyers during the sales period. All PMX tokens will have the same equal value and possibilities of usage.

Rate of exchange rate:
1 BTC = 120,000 PMX (subject to BTC/USD changes in exchange rate) or equivalent in ETH
Maximum funds raised: 1.75 billion PMX (subject to change in exchange rate)
Minimum financing: 200 M PMX
Token contract address: To Be Announced
Launch date and time: To Be Announced
Token launch time-frame: 30 days
Token launch completion: token launch will end when either the maximum number of PMX are raised or 200 M PMX are sold. If less than the minimum PMX are raised, BTC or ETH will be returned to the sender’s address.

Size of Market Opportunity
Block23 focuses on two key market opportunities:

Targeted drug development
An open source Block23 platform can share data and transfer value more efficiently and productively. Collected personal health data leads to multiple market opportunities such as targeted drug development.

The current methods of drug development is very expensive and time consuming. On average, a successful new drug development costs $2.6 billion with a development cycle of 10-15 years time. In 2015, the top 50 pharma companies spent a total of $111 Billion for drug development.

According to Pharmaprojects Pharma R&D Annual Review 2017,

“more than ever before, there are herds of cancer drugs sweeping majestically across the pharma plain. The population of Oncological therapeutics has shot up far faster than the pharma average, increasing its citizenry by 669 candidates, a growth rate of 16.0%, even just surpassing last year’s record-breaking 15.9% rise. This puts it in 2017 growing at almost twice the rate of the
pipeline as a whole, and taking a 32.6% share of the pie – almost a third.”

As a subset of this cost, the estimated value of personal medical data research units based on current expenditures and forecasted demand exceeds $10 Billion per year in total and $3.6 Billion for cancer drugs. For example, Genentech paid $60 million 23&me in 2015 for accessing 3000 patients’ genomic data at an average cost of $20,000 per patient record.

Real Word Data and Real World Evidence data:
Real world data (RWD) and real world evidence (RWE) play an increasing role in health care decisions:

- The FDA uses RWD and RWE to monitor post-market safety and adverse events and to make regulatory decisions.
- The health care community use this data to support medical insurance coverage decisions and to develop guidelines and decision support tools for use in clinical practice.
- Medical product developers use RWD and RWE to support clinical trial designs (e.g., large simple trials, pragmatic clinical trials) and observational studies to generate innovative, new treatment approaches.

4.5 Utility Token Model
Cryptocurrencies such as Bitcoin and Ethereum are highly volatile and make real-world usage for daily transactions nearly impossible, especially when daily swings can be up to 20% against a fiat currency.

A ‘stable token’ is a cryptocurrency that is pegged to a stable asset such as the U.S. dollar. The token’s central characteristics are that it can be used as global currency, has low volatility and is not tied to any central bank. Stability, scalability, privacy, and decentralization would allow everyday use of the cryptocurrency to view films, purchase merchandise or receive discounts on products.

In a report on virtual currencies, Dutch economists present a view that their value consists of three major factors:

1. The utility of the virtual currency to make payments
2. The decision of forward-looking speculators to regulate the supply of virtual currency
3. The elements that drive user adoption and merchant acceptance of a virtual currency.

Whereas # 2 does not play a role in the case of real utility token, it can play an important role in exchange rates by limiting the supply of tokens and therefore increasing the token’s rate of exchange in a short time period. Over time, the exchange rate is increasingly influenced by the token’s utility and adoption instead of a speculative view. This dynamic has been observed in more mature virtual currencies and even though models are imprecise, this one presents a view for long-term price stability as a result of token usage.

Because Block23 is creating both a security token for investors that fits the #2 scenario as well as a utility token for exchanging products and services, the speculative interest on BFT tokens is
limited. The price, stability and liquidity of the PMX utility token will be further mitigated by the following factors:

- By the reserve fund created from the sale of PMX tokens, which will used to buy and sell PMX tokens on the listed exchange
- By brands and merchants purchasing PMX to give to consumers in exchange for access to their Data Profile
- When consumers buy BFT tokens to purchase tokens and use BFT when purchasing providers services and products

The following charts illustrate a PMX utility model. The assumptions are based on an adoption rate by people and health care providers, as well as the exchange of goods and services with PMX.

Chart #1 : PMX net inflows over time
PMX outflows are from PMX holders exchanging PMX for other crypto. PMX inflows are the amount of PMX purchased by Health care providers and sent to people in exchange for their Data Profile. The chart indicates that PMX inflows are positive and are in proportion to the increased adoption by people and health care providers.

![PMX net inflows chart](image)

Chart #2: PMX spent on goods/services vs. sold on exchanges
PMX received by people have a % sold for crypto vs. used for purchases of goods and services. As adoption increases, people have a wider choice of health care providers and more attractive PMX deals to choose from. Therefore, the % of PMX used vs. sold is logically expected to increase over time.
Chart # 3: average PMX received by people for their data profiles
If we assume that a people receive an average monthly amount of 14 PMXs per Provider, then as the number of different types of health care providers increase, the average total PMXs received by a people would increase over time. This directly contributes to PMX inflows.
**R&D**
Platform development will be focused on core smart contracts and security, user wallet, management interfaces, customization tools, and integrations with crypto exchanges.

**Reserve Fund**
15% from the sale will be used as a reserve fund for supporting the buying and selling activities in the token smart contract.

**Business Development**
Business development efforts will identify and form partnerships with pharma, health care providers, insurance partners.

**Marketing**
Marketing activities will be focused primarily on creating demand on app marketplaces and social sites for people/patients to receive free app and wallet on Blockchain. The offer will include free genomic scans for the first 5,000 to 10,000 registered users.
5. **Benefits**

Stakeholders within the Block23 eco-system include people/patients, medical R&D, pharma, health care providers and receive the following benefits:

**For people**
By joining the Block23 community, people receive the following benefits:

1. **Health and quality of life:**
   - Improve people’s cancer prevention and treatment
   - Improve communication between patients / individuals and 3rd party such as physician or healthcare provider
   - Digitalized and standardized personal health life data
   - Improve disease & life time health management

2. **Financial:**
   - Patients and individuals receive free genomic sequencing
   - PMX rewards each time their data is accessed. The higher the data grade, the more token rewards.
   - Exchange of services based on tokens provided by Block23 partners such as cancer treatment specialists

3. **Emotional:**
   - Sense of great contribution to society and support of “cancer moonshot”
   - On-going use of PMX tokens help to sustain the “life” of cancer patients, in memory of family and friends.

4. **Technical:**
   - **Universality:** PMX tokens acts a currency for receiving services and can be used with any Block23 partners.
   - **Flexibility:** acquired tokens on Block23 are freely transferrable across physicians, as well as with friends and family.
   - **Maximum usage:** tokens can be utilized where they count the most depending on where the best deals are.
For health care providers, pharma and research units
Health care providers benefit by accessing a personal health data, interacting with patients and with other members within Block23 community. Decentralized data and PMX tokens provide a secure translation between people and professionals to improve data quality and the cost and efficiency when providing services.

Research units, scientists and pharma benefits:

- Reduced cost and time on drug and assay development as a function of access to large patient data sets for recruiting people to be part of a study.
- Machine learning and decentralized research tools that increase the success rate of drug and biomarker discovery.
- Post market survey and health economic analysis that tracks patients at each stage of clinical trial.
  - Secure patient consent and simplified signature process via smart contracts.

Health care provider benefits:

- Blockchain AI deep learning system to support diagnosis and treatment decision.
- Digitalized and standardized personal health data for aligning the right patient at the right time with the right treatment.
- PMX tokens create business opportunities and value exchanges within the Block23 ecosystem of patient-researcher-health care provider.
6. Implementation

The implementation of Block23 would face various challenges at the beginning. With more patients, individuals, developers, and partners join the use of Block23, and see the benefits emerges, Block23 would attracts increasing attention from different stakeholders.

6.1 Barriers to adoption

Our experience working in health care and as witnessed in large scale, highly structured projects, major barriers include:

- **Institutional mistrust**: people mistrust government sponsored initiatives and providing personal medical data and are reluctant to participate.

- **Data Normalization and Access**:
  - Electronic Medical Records (EMR) – EMR are stored currently in medical institutions, and lack of semantic interoperability has prevented a system that would generalize all data and store in one vault.
  - Data Privacy: most countries protect patient data by not allowing export of EMR.

- **Screening Costs**: full sequencing costs have dropped significantly to the range of 250 USD per person but when sequencing large population groups, a total project cost represents a significant investment.

- **Data Continuity**: in addition to genome sequencing of somatic cells which is a one time event, other data continuously changes over time - for example EMR, tumor DNA/RNA data, records from biochemistry, microbiome, nutrition, lifestyle, data from wearables. This additional data is key to understanding what contributes to cancer development.

- **Data security**: as noted, stolen medical data has higher value than credit card data to hackers.

- **Onboarding partners**: medical research centers and pharma have a long standing practice to keep data in silos and not sharing information.

The above factors need to be addressed in a go-to-market and partner development strategy that quickly grows the network of connected providers. External market pressures help to weaken resistance, but a compelling proposition for change is required.
6.2 Overcoming the barriers

There are several important factors to drive momentum, achieve a critical mass of users and gain confidence within the eco-system:

1. **Developing trust by engaging people**: a significant PR and social media marketing effort will explain the benefits of medical data on Blockchain. Most importantly, the campaign will tap into a deep emotional need for achieving a cancer breakthrough by taking part in a great global movement where each person’s actions directly contributes to helping find a solution.

2. **Providing a motivation**: a free app with deposited tokens that can be used for services will be promoted on social media, app marketplaces and medical portals. The same tactic was effectively used by PayPal to sign up hundreds of thousands of customers in the first month. Physicians will additionally be motivated for Block23 referrals as a way to connect to specialists in post cancer management including peer consultations, nutritional and daily care services and more.

3. **Solving the data access and normalization issue**: because patients have rights to their own EMR data, obtaining source data and uploading it to their personal lockbox on the Blockchain is within data privacy frameworks. Block23 DNN algorithms will be able to structure and normalize the data in most cases even when source data is an image format.

4. **Making the economics work**: reliable sequencing companies will be invited as free sequencing providers or as data partners where the cost of the sequencing will be denominated in PMX tokens.

5. **Data security**: the ultimate personal healthcare data vault enables personal data to be securely stored on the chain, free from any possible breach and accessible to the owner anywhere, anytime when needed (e.g. in case of an emergency).

6. **Creating a customer centric eco-system**: the Block23 eco-system joins partners providing services, consumers and patients with a new level of precision medicine and healthcare services where people are rewarded with tokens for sharing and uploading his/her personal health data where tokens are used for purchasing goods and services.

7. **Strategic partnerships**: Block23 will develop strategic partnerships with providers of services such as health care insurers who will benefit from having access to new potential customers

8. **World wide partner network**: an existing SMI partner network that already has tens of millions of registered customers which will be supplemented with a partner developer community to introduce Block23 to their audience.

9. **Loyalty partners**: SMI manages loyalty programs for major retailers and loyalty coalition providers, each of whom have more than 3M registered members, providing a good start up database of more than 25M members to send out offers to.
6.3 GTM strategy

Developing the Block23 ecosystem focuses on patients/individuals who generate data, and industry players (research institutes, pharma, insurers, regulators) which need data for research and development of precision medicine.

The Block23 business development team will focus on partnerships and major drug and assay development and healthcare markets including UK, US & Europe. A marketing and sales team with medical background will be responsible for positioning, healthcare regulations, promotion, martial development, media strategy and budget control.

Onboarding People/Patients and Providers

On boarding both people and providers is the obvious key to Block23’s fast scale of adoption. Block23’s GTM plans includes a bonus and referral incentive for consumers and various means that will drive new business to merchants.

For people, Block23 will incentivize adoption with:

- an opening account bonus of 3600 PMX for data that is designated as ‘full share’ for a 3 month time period
- a spending bonus of 10 PMX for every 100 PMX of provider purchases
- a referral bonus of 10 PMX for every referred consumer opening a PMX wallet

For providers and pharma, Block23’ will drive business and save on new customer acquisition and drug trial costs by:

- providing 3 months of clearing transactions without gateway fees
- 3 months of free ads to people who have agreed to share their PMX with providers

The net effect will be to scale out a user base up to a point where the value of the connected reward network exceeds any bonus given, at which point the incentive program will no longer be needed.

Partnering with sales organizations

Block23 will invite and attract contract sales organizations and representatives as partners to reach out to medical professional, especially physicians to use Block23 as a patient management tool which could help increase their efficiency in guiding their patients during prevention, treatment and recovery.

Web partners

Currently, Block23 is selecting sequencing partners in the different locations worldwide to ensure data consistency and high quality. Additionally, creating relationships with well-known medical and health websites, for instance WebMD and “patients-like-me” communities will push Block23 into public awareness. Additionally, Block23 will invite and attract other on-line platforms & communities to recruit the patients or individuals on a referral reward system.
Servicing cancer research
Health insurance companies, pharmaceutical companies, medical research facilities, precision medicine practitioners, sequencing companies are the main consumers for the data generated by Block23. However, very few of these have AI machine learning capabilities to data mine and analyze complex, multi variant data sets for research, development of innovative drugs, treatments, and services to tackle cancer.

Block23’s in-house sales team will offer its open platform and AI team to discover new mutations, new pathways as new targets for drugs or treatment methods to kill tumor cells.

Targeted products for insurance companies
The business of insurance companies is based on the actuarial science and data. The data sets acquired from individuals and supply to actuarial team for them to design more accurate products for customers, maximize the profit in the insurance products.

Block23’s in-house sales team will offer its precision data sets that provide an economic analysis to insurance companies and regulators for new drug pricing.

Coalition loyalty network
Block23’s PMX token will power a customer loyalty program, offering deals and transparency on offers from healthcare service and product providers such as insurance products, on-line medical consultation, disease management, personalize nutrition, direct to patient drug delivery and more. For example, cross-marketing deals between insurance companies and providers can also deliver health care management services at a lower cost for claims due major illness.

6.4 Competitive advantages
Compared to current medical data record and management providers, the benefits and advantages of Block23 are significant, not only on the technology itself, but also on the ecosystem that Block23 is building.

Accurate, authenticated data sharing
As Block23 is based on the Blockchain where all data cannot be altered and accessed by a third party without the permission of the data owner. The individual now has 100% ownership of their data and can decide what data is shared and on what terms using Block23’s app using Ethereum’s smart contract technology (see Architecture, section 10). With data on the Blockchain, authenticity, accuracy and trust are provided in a way that is currently unavailable. ensuring that research and clinical trials are free from data manipulation and fraud.

Unlocking discoveries via IoT and AI
Combining EMR and live streamed health data (e.g. wearables, mobile apps, connected equipment, glucometer, body fat weighing scale) provides richer, deeper data than large scale biobank, or cohort studies that are designed for time limited research purposes. With Block23’s deep learning algorithms identifying associations, among genotypes, phenotypes, gut microbiome compositions, lifestyle, dietary patterns, as well as other unique living circumstances is made possible.
Providing an open platform for breakthroughs
Hoarding valuable medical data for commercial purposes is part of the dark story on why the health care industry doesn’t serve the interest of people. With an open platform, AI scientists around the world are able to join Block23 and be challenged with the task of discovering cancer breakthroughs, serving the interests of society enriching the Block23 ecosystem.
7. Team

7.1 Core Team

**Paul (Prem) Couture, Founder, Chief Architect**
Prem is the CEO and principal architect at Cyscom-ShareInsight (SMI), a UK technology company developing technologies using AI and machine learning for big data analytics on consumer behavior. He is the co-founder at Genex8, a biotechnology and genetic venture formed with leading European scientists at Oxford University in cancer research with over 20 patents on biomarkers that measure drug response to cancer tumor cells, with the goal to improve R&D cycles via a cutting edge, cloud based bioinformatics platform. Prem’s experience includes IoT sensor fusion and Deep Learning and is the inventor and patent holder of a technology that speeds up the neural processing of information as generated from computer generated graphics. He has extensive experience in implementing software technologies and solutions with leading enterprises in Retail, Life Sciences, Banking and Finance and is the founder of several international internet software businesses that developed and brought to the market a comprehensive Cloud Computing Platform and applications to major IT service companies such as Hewlett-Packard.

Prem’s current focus is on a Blockchain CRM solution for retail that empowers consumers via a universal reward currency, the REV token and Block23 for breakthroughs in cancer research.

**Professor David Kerr, Founder, Chief Strategy Officer**
Dr. Kerr  CBE MA MD DSc FRCP (Glas, Edin & Lon) FRCGP (Hon)FMedSci, contributes to Oxford as Professor of Cancer Medicine, where he has worked with colleagues to build a new Institute for Cancer Medicine and Cancer Hospital. He is also Adjunct Prof of Medicine at Weill-Cornell College of Medicine, Xiamen University and the Second Military University of Shanghai. He has an international reputation for the treatment of and research into colorectal cancer and the quality of his work has been recognised by the award of several international prizes and the first NHS Nye-Bevan award for innovation. He has published over 400 papers and has an H-Index of 80 associated with over 25,000 citations. He has founded 3 University spin outs; COBRA therapeutics, Celleron Therapeutics and Oxford Cancer Biomarkers. He has made a significant contribution to reforming the NHS as a Founding Commissioner for Health Improvement; Chair of the National Cancer Services Collaborative, Instigator of the Department of Health’s networked approach to clinical cancer research and developed a 20 year plan for the future of the NHS in Scotland, the “Kerr Report”. He was elected Fellow of the Academy of
Medical Sciences in 2000, the European Academy of Cancer Sciences in 2006, Honorary Fellow of Royal College of General Practitioners in 2007, appointed Commander of the British Empire in 2002 by HM the Queen and was elected President of the European Society of Medical Oncology in 2010. He has established INDOX and Afrox to improve the quality of cancer care in India and Sub Saharan Africa and has served as Health Adviser to two British Prime Ministers, Tony Blair and David Cameron.

**Ian Brown, Chief Business Development Officer**

Ian is an experienced Entrepreneur in the International Healthcare Biotech/Medtech Industry. Ian was a co-founder of a medical technology start-up company which grew to become an International leader in vascular DVT prophylaxis with an exit valuation of over $200 million when sold to a US corp. Ian has been involved in a number of start-ups which have raised significant amounts of funding through IPO’s and also with HNW’s/ VC/PE groups both in the UK and Europe. He has worked in over 20 countries setting up distribution, JV’s and sales/marketing groups. He has a wealth of experience in clinical research and product development having co-developed a Medtech product that was patented worldwide. He was also a founder member of the International consensus statement for thrombosis prevention. Ian is currently a member of a team planning to relocate and build a new hospital for the NHS in Kent. He has also a founder member, investor and advisor of a £400m project that will be developed into a senior living/extra care community hub to include medical facilities. Ian is working, as Non-Exec Chairman, with a Swiss based group that are establishing a £100m STO in Malta for Biotech companies seeking 2nd or 3rd round funding.

**Professor Håvard E. Danielsen, Bioinformatics Lead**

Professor Havard E. Danielsen is a geneticist with a PhD in medicine from the University of Oslo. He is the Director of the Institute for Cancer Genetics and Informatics at Oslo University Hospital (Norway) and holds positions at the Department of Informatics, University of Oslo, and at Nuffield Division of Clinical Laboratory Sciences at the University of Oxford. Danielsen is PI of the DoMore! project, which was the winner of a prestigious Lighthouse Project grant from the Norwegian Research Council, and he also serves as a PI at the Centre for Cancer Biomedicine. His research focuses primarily on DNA- and chromatin organization, using informatics as a tool to study genomic changes in cancer.

**Dr. Weiyan (Jackson) Zhu, Head clinical data science**

Dr. Zhu has 22 years experience of Pharma and Consumer HealthCare businesses, has been the Business head both in China and Western Europe at Boehringer-Ingelheim (BI) a Global top 20 pharmaceutical company. He is the first Greater China Country Manager in Catalent (CTLT), NYSE and chest surgeon at Shanghai Huadong hospital. He is the Founder and CEO of start-up companies in the areas of precision medicine and brings extensive management experience in managing sizable multinational business as well as being a clinical data management expert. Dr. Zhu has founded a first Precision Medicine commercialization platform in China, established a CLIA, CAP & China standard Clinical lab to service global market and form strategic partnership with leading Bio companies in UK/US such as the Oxford University Cancer Biomarkers company and has extensive strategy development experiences at both global and local markets as well as in direct to consumer communication in consumer facing medical businesses.
Dr. Gualberto Ruaño, VP Business Development
Dr. Gualberto Ruaño is a pioneer in the field of personalized medicine and the inventor of molecular diagnostic systems used worldwide for the management of viral diseases. Ruaño is President and Founder of Genomas, a genetics-related company and now the bio-tech anchor of Hartford Hospital’s Genetic Research Center; he also serves as Director of genetics research at the Center. He was elected to the Connecticut Academy of Science and Engineering and is the Chairman of the Academy's Health Care and Medical Technology Board. He is senior editor of the journal of Personalized Medicine. Ruaño serves on advisory committees of the American Association of Clinical Chemistry and of the National Academy of Clinical Biochemistry instituting guidelines for pharmacogenetic testing in the clinical laboratory. He was elected as a Fellow of the National Academy of Clinical Biochemistry and received the Beacon Alliance Medical Technology.

Kasper Ditlevsen, Go to Market, VP Sales
Kasper is an accomplished, entrepreneurial and qualified Senior Executive in both a Corporate and Management Consultancy capacity in Health Care, FMCG and CPG sectors. Significantly experienced in operating companies with billion dollar P&L accountability and leading large multi-functional and multi-cultural teams with industry credentials across the the health care environment. Equipped with a demonstrable track record of success initiating, developing and executing sales, price, brand, and customer strategies focused on driving aggressive and sustainable revenue, margin and market share growth.

Alexander Shivarov, Chief Bio-Informatics Scientist
Alexander, M.S. in computer science, is a visionary data science executive with broad spectrum of domain expertise, technical knowledge, and proven success in bringing measurable added value to companies and domains (data science, operations research, machine learning, computer science, business intelligence, IoT). He has invented many synthetic metrics that work better than old-fashioned stats, especially on disparate data sets in a Map-Reduce, Hadoop environment.

Alexander has developed and implemented computational biology tools and programs to support gene research activities and has generated and tested hypotheses on genome-scale data using analytical and statistical methods. Alexander has pioneered highly innovative visualization, machine learning, optimization and statistical inference solutions for pressing Healthcare and Life Science challenges using very large scale proprietary and public data sets, computing infrastructure and insights from expert Healthcare partners.

Alexander’s current focus is on coupling AI with Blockchain technologies to analyze data securely and to make quicker, more accurate predictions.

Nikolay Belostotsky, Data Science, Lead Engineer
Nikolay holds a Master’s degree of engineering and technology in the field of computer science from Baumansky Institute in Moscow with experience in implementing smart contracts and Blockchain applications. Nikolay has strong mathematical background with strong knowledge in at least one of the following fields: statistics, data mining, machine learning, statistics, operations research, econometrics, natural language processing, and/or information retrieval.
In projects involving major universities, Nikolay has created models, structured data and implemented algorithms to support analysis using advanced statistical and mathematical methods from statistics, machine learning, data mining, econometrics, and operations research.

**Konstantin Lomakin, CFO**  
Head of Corporate Banking at Evrofinance Mosnarbank, and Deputy Head of Private Banking Uralsib. Konstantin is a professional corporate banker and independent financial advisor on a diverse range of projects, ranging from commodities to aerospace engineering. He brings with him a unique blend of multifaceted work experience in banking, private wealth management, financial analysis and sales and marketing to support the REVOZ project at all pre and post ICO stages.

### 7.2 Advisory and Board

**William Johnson, Boler Biotech**  
William Johnson is Managing Partner at Boler Biotech Consulting with over 25 years experience working in the biotechnology and pharmaceutical fields. He previously held positions as research scientist at EMD Millipore, and as a consultant at Bullet Biotechnology. Prior to this, William held key research leadership and supervisory positions at Novartis, Wyeth, the Broad Institute of MIT and Harvard University, Dana-Farber Cancer Institute, Mayo Clinic, The Scripps Research Institute, and others. William holds a Master of Science in Molecular Neuroscience from the Mayo Clinic Graduate School and a Bachelor of Science in Biology from the University of Oregon. William has proven expertise across therapies targeting cancers as well as business expertise as an equity partner, adviser to company leaders and boards.

**Kees Roks, CEO Novartis Canada, Latin America**  
Kees Roks has 30 years of international big pharma experience gained in country organizations (the Netherlands, Germany, Norway, Japan and Russia) and Regional Management (Europe, Latin America & Canada) with specific responsibilities in sales, marketing, project management, strategic planning and general management. He has in depth knowledge of all major therapeutic areas within the pharmaceutical industry and is the Head of Novartis Oncology. In this role, he is responsible for commercial development activities. Most recently, he served as Head of the Western European Cluster (WEC) for Novartis Oncology, which included the Nordics Cluster, Belgium, the Netherlands, Switzerland, Austria and Portugal. Kees is currently the head of Novartis for Canada and Latin America

**Georges Al Medawar, ICO Strategy, Partnerships,**  
Georges is the Co-Founder of Omnistry and was the Chief Business Development officer at HumanIQ. He is actively in a wide specter of global focused disruptive technologies. Georges is currently on a research and development project involving the study of Distributed Ledger Systems, mainly the applied uses and the resulting societal and economic implications to governance models.
8. Road Map

8.1 Current Technologies and Organisation

DEVELOPED TECHNOLOGIES

- AI and Deep Learning algorithms for joining/analyzing disparate data sets and transforming phenotype and genotype data into insight on the fly.
- GPU accelerated computing with an analytical processing engine for big data modeling, along with dashboards and interactive visual controls for fast exploration and discovery of data patterns.
- CRM engine with automated processes that trigger product and service offers at key moments of engagement people looking to make a purchase and on their preferred communication channel, delivering more efficient engagements, sales conversions and savings.
- A bio-informatics platform that captures and analyses high-quality multi-institution medical data, designed to connect patients, doctors and research scientists for expedited research and therapy development.
- Standardized scientific data collection model across participating organizations performing clinical evidence-based pharmaceutical research.
- An Electronic Data Capture (EDC) system to automate the collection of structured data relating to all aspects of healthcare (such as diagnosis, medication, laboratory test results, genetic, radiological and imaging data).
- DNN and data mining techniques to automatically identify associations between the structured data in the EHR (history of the patient, history of illness, treatments regimes, medications and lab results), deviation from the standard values from the reference knowledge base, and to further investigate disease comorbidities, patient stratification, drug interactions and clinical outcome.
- A fine-grained longitudinal phenotypic profiles, biobanks and genetic data repository, together with systems biology approaches, for downstream personalized medicine development, patient safety improvement, and informed clinical decision making assistance.
OPEN DEVELOPMENT PLATFORM

It is the core concept of Block23 to enable third parties to develop health care applications using Block23’s Open Development Platform and the PMX crypto currency as a reward and value exchange token.

ORGANISATION

The current organization includes a highly skilled team of experts in their relative fields of

- Technology team experienced in Blockchain technologies, smart contract applications, big data processing, industrial product design and manufacturing
- Scientific and bio informatics resources with academic and industry experience to perform pathway, network and other meta-analysis of relevant collection of internal and external omic data, capable of defining patient populations, surrogate markers, drug repositioning and defining effective drug combinations in order to generate actionable scientific insights
- Sales and customer support team in major markets including North America, EU, CIS, Middle East and Africa
- World-wide partner sales channel servicing health care sector.
- Current offices in Reading UK and Moscow, Shanghai and Oslo.

8.2 Product and Business Development

Summary Project Timeline

Q2, 2018

R&D: TECHNOLOGY DEVELOPMENT PLAN

PMX Tokens for eco-system participants

- Extend the development platform for creating and managing reward tokens with smart contracts powering the framework as well as the general web interface,
• Ensure wallet compatibility on any mobile web-enabled device, including tablets and PC, with iPhone and Android apps offered. The universal wallet to operate on an Electrum-style approach, with no downloads required.

PRODUCT DEVELOPMENT PLAN

**Block23 application and crypto wallet**
• Development of Block23 application for managing transactions that is modular, connects to Blockchain CRM, enabling providers to configure their offers as a reward system in the form of tokens which are transferrable between providers.
• Develop a transactional platform on Ethereum using smart contracts for mediating exchanges between people, pharma and providers, generating a toll type transaction and revenue model for Block23

ORGANISATION PLAN
• Opening of new office in North America
• Hire Blockchain developers for wallet and user interfaces, new applications, integration protocols
• Hire additional partner project and support team resources
• Install Block23 platform and applications to run on AWS for servicing N.A. customers

SALES AND IMPLEMENTATIONS
• Grow the partner network and community into N.A.
• Expand the EU partner network to increase the number of providers to 100
• Develop strategic partnerships with research institutes and pharma
• Develop joint ventures with technology partners and major health care providers

Q3-Q4 2018

R&D: TECHNOLOGY DEVELOPMENT PLAN

**PMX token for providers**
• Continued development of the Block23 platform and integration with the Ethereum framework
• Test prototype of mobile wallet to allow providers to send crypto using text message or email; trial wallet compatibility on iPhone and Android; evaluate usability and user experience

PRODUCT DEVELOPMENT PLAN

**Block23 application and crypto wallet**
• Continued work on the development of the Block23 application and PMX wallet
ORGANISATION PLAN

- Opening of new office in Singapore
- Hire additional Blockchain developers for continued work on wallet and user interfaces
- Hire Blockchain developers for wallet and user interfaces, new applications, integration protocols

SALES AND IMPLEMENTATIONS

- Expand the partner network into Asia
- Expand partner channel and partnerships with global providers serving related health care industry
- Grow the coalition of Block23 providers in cross service industries, such as insurance and financial services, enabling a cross industry crypto loyalty network
- Create new joint ventures with technology partners and service providers

Q1-Q2 2019

R&D: TECHNOLOGY DEVELOPMENT PLAN

Live testing
- Live tests with selected partners, providers and people/patients
- Conduct test transactions on embedded wallet
- Final design specifications and support requirements for live roll out

PRODUCT DEVELOPMENT PLAN

Block23 application and PMX wallet
- Continued work on the development of a new Loyalty Management application and wallet.

ORGANISATION PLAN

- Hire additional Blockchain developers for continued work on wallet and user interfaces
- Hire additional Revoz developers for continued work on new applications, integration protocols
- Hire additional project and support team resources

SALES AND IMPLEMENTATIONS

- Go live end of Q2 2019 with selected providers
- Expand partner channel and partnerships with global coalition of providers serving non-health sectors such as insurance and equipment providers
- Create new joint ventures with technology partners and service providers
- Distribute app to people/patients with free genome scans
8.3 Security and Testing

We have studied recent hacking methods on exchanges and user wallets. We have examined carefully points of vulnerability that allow wallet addresses to get tracked and enough information uncovered for hackers to reconstruct private keys.

We have run models on how generated transactions may be compromised and how a corrupted data source can impact the security model. In order to address vulnerabilities, we will adopt Ledger’s new custodian service for enterprises and its enterprise grade cold storage solution based on HSM (Hardware Security Module) and hardware authenticators, enabling multi-currency, multi-signature, rate limiting and time locking.

Block23 utilizes MS Azure’s Ethereum sandbox for building, testing and deploying Daaps in an emulation of a live network, allowing to thoroughly test applications and how they interact with smart contracts before live deployment.
9. Partner Financial model

Partners in the Block23 community are able to develop and offer various revenue based services such as:

- Data access fee for drug/assay development, RWE, health economic analysis etc.
- Patient recruiting for clinical trials
- Products and services for patients & individuals

The commercial benefits for partners are sufficiently compelling for them to invest in an effort for acquiring data and customers. The revenue estimations below are based on existing statistics and are represented in PMX and in USD based on an exchange rate of 16 PMX per $1 USD (subject to change).

9.1 Data access fees

Partner access personal data lockboxes to further develop drug development or RWE datasets using Block23 AI capabilities.

Partners charge a data access fee of between PMX 3,200 to 80,000 ($200 to $5,000 USD) per study depend on the grade of PMX. A reasonable forecast is 200,000 patients and 100,000 individuals at year 3, generating revenues of PMX token 5,081,600,000 ($317,600,000 USD).

<table>
<thead>
<tr>
<th>Grade</th>
<th>token/PMX</th>
<th>Num. PMX</th>
<th>Avg. use rate</th>
<th>Total Tokens</th>
<th>Y1</th>
<th>Num. PMX</th>
<th>Avg. use rate</th>
<th>Total Tokens</th>
<th>Y2</th>
<th>Num. PMX</th>
<th>Avg. use rate</th>
<th>Total Tokens</th>
<th>Y3</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>3,200</td>
<td>10,000</td>
<td>0.3</td>
<td>9,600,000</td>
<td>30,000</td>
<td>0.3</td>
<td>28,800,000</td>
<td>60,000</td>
<td>0.3</td>
<td>57,600,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G2</td>
<td>16,000</td>
<td>12,000</td>
<td>0.4</td>
<td>76,800,000</td>
<td>50,000</td>
<td>0.4</td>
<td>320,000,000</td>
<td>100,000</td>
<td>0.4</td>
<td>640,000,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G3</td>
<td>32,000</td>
<td>25,000</td>
<td>0.5</td>
<td>400,000,000</td>
<td>35,000</td>
<td>0.5</td>
<td>560,000,000</td>
<td>70,000</td>
<td>0.5</td>
<td>1,120,000,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G4</td>
<td>48,000</td>
<td>15,000</td>
<td>0.7</td>
<td>504,000,000</td>
<td>20,000</td>
<td>0.7</td>
<td>672,000,000</td>
<td>40,000</td>
<td>0.7</td>
<td>1,344,000,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G5</td>
<td>80,000</td>
<td>8,000</td>
<td>0.8</td>
<td>512,000,000</td>
<td>15,000</td>
<td>0.8</td>
<td>960,000,000</td>
<td>30,000</td>
<td>0.8</td>
<td>1,920,000,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>70,000</td>
<td></td>
<td>1,502,400,000</td>
<td>150,000</td>
<td>2,540,800,000</td>
<td>300,000</td>
<td>5,081,600,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*MS% 0.94% 1.59% 3.18%
9.2 Patient recruiting for clinical trials

In drug and assay development, patient recruiting is one of the most challenging parts for clinical trials. Patients with well-structured health data in Block23 platform offer the best recruiting place for clinical trial. Clinical trials statistics from 2017 shows that 123,841 were newly registered drug or bio, GAGR 14% from 2010.25

The recruiting fee is charged per study. The service fee of approximately PMX tokens 592K to 4,200K per study ($37K to $300K USD) is based on table 2 in ASPE report.26 A reasonable forecast is 14,000 patients, 10% of the total Block23 patients are recruited for 51 clinical trials at year 3, generating revenues of PMX 1,843,602,933 ($115,225,183USD).

The following forecast assumes 12 trials over a 3 year time period, executed and staged over time:

<table>
<thead>
<tr>
<th>Patient recruiting</th>
<th>Y1</th>
<th></th>
<th></th>
<th>Y2</th>
<th></th>
<th></th>
<th>Y3</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. patients</td>
<td>No. trials</td>
<td>Total Tokens</td>
<td>No. patients</td>
<td>No. trials</td>
<td>Total Tokens</td>
<td>No. patients</td>
<td>No. trials</td>
<td>Total Tokens</td>
</tr>
<tr>
<td>Phase I</td>
<td>29,640</td>
<td>300</td>
<td>75</td>
<td>8,892,000</td>
<td>500</td>
<td>125</td>
<td>14,820,000</td>
<td>1,000</td>
<td>250</td>
</tr>
<tr>
<td>Phase II</td>
<td>25,782</td>
<td>1,000</td>
<td>50</td>
<td>25,782,400</td>
<td>3,000</td>
<td>150</td>
<td>77,347,200</td>
<td>10,000</td>
<td>500</td>
</tr>
<tr>
<td>Phase III</td>
<td>16,463</td>
<td>3,000</td>
<td>50</td>
<td>49,387,520</td>
<td>8,000</td>
<td>133</td>
<td>131,700,053</td>
<td>80,000</td>
<td>1,333</td>
</tr>
<tr>
<td>Phase IV</td>
<td>2,391</td>
<td>4,000</td>
<td>10</td>
<td>9,565,536</td>
<td>40,000</td>
<td>100</td>
<td>95,655,360</td>
<td>100,000</td>
<td>250</td>
</tr>
<tr>
<td>Total</td>
<td>8,300</td>
<td>185</td>
<td>93,627,456</td>
<td>51,500</td>
<td>508</td>
<td>319,522,613</td>
<td>191,000</td>
<td>2,333</td>
<td>1,843,602,933</td>
</tr>
<tr>
<td>total patients</td>
<td>166,667</td>
<td>666,667</td>
<td>2,000,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>recruit rate%</td>
<td>5%</td>
<td>8%</td>
<td>9.6%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*MS%</td>
<td>0.4%</td>
<td>1.2%</td>
<td>5.7%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9.3 Services & Products

Partners can develop personalized services and/or products based on personal health data in Block23 platform, such as:

- On-line disease management like cancer screening and monitoring
- On-line health care consultation i.e. nutrition, self-medication for individuals
- Personalized products i.e. Direct to patient (DTP) pharmacy and personal nutrition capsule

Service fees & product sales of approximately PMX 480 to 1,600 per ($30 to $1,000 USD) can be charged. A reasonable forecast is 5% to 13% of the total Block23 individuals are using these services or buying products at year 3, generating revenues of PMX 1,264,000,000 ($79,000,000 USD).
<table>
<thead>
<tr>
<th>Services &amp; products</th>
<th>Y1</th>
<th>Y2</th>
<th>Y3</th>
</tr>
</thead>
<tbody>
<tr>
<td>token/services or products</td>
<td>Users</td>
<td>Coverage %</td>
<td>Total Tokens</td>
</tr>
<tr>
<td>personalized products</td>
<td>480</td>
<td>4,000</td>
<td>2%</td>
</tr>
<tr>
<td>on-line consultation</td>
<td>800</td>
<td>10,000</td>
<td>4%</td>
</tr>
<tr>
<td>online disease management</td>
<td>3,200</td>
<td>5,000</td>
<td>2%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>25,920,000</td>
</tr>
<tr>
<td>Total Users</td>
<td>250,000</td>
<td>1,000,000</td>
<td>3,000,000</td>
</tr>
<tr>
<td>frequency /year</td>
<td>1.0</td>
<td>1.5</td>
<td>2.0</td>
</tr>
</tbody>
</table>

9.4 Gateway fees

Gateway fees are transactional fees for purchase of PMX tokens by providers (e.g. insurance companies, pharma, retailer) or when tokens are redeemed by people for purchasing a service or product.

For example:

- a pharma company purchases PMX on an exchange for recruiting patients on a drug trial and tokens are then issued to the wallet address of the pharma for a smart contract to recruit patients
- a person has tokens in a wallet from a drug trials and redeems the tokens when purchasing a health insurance policy from an insurance company

The following forecast is based on total transactions of data access fees (9.1) + patient recruiting fees (9.2) and service/product purchases (9.3), generating revenues of PMX token **26,732,000** ($1,670,750 USD) at year 3.

<table>
<thead>
<tr>
<th>Transaction Fees</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total transaction amounts (9.1 + 9.2 + 9.3)</td>
<td>1,546,060,000</td>
<td>2,641,212,000</td>
<td>5,346,416,000</td>
</tr>
<tr>
<td>Gateway fee %</td>
<td>0.50%</td>
<td>0.50%</td>
<td>0.50%</td>
</tr>
<tr>
<td>Total Transaction Fees</td>
<td>7,730,000</td>
<td>13,206,000</td>
<td>26,732,000</td>
</tr>
</tbody>
</table>

9.5 Total Partner Forecasted Revenues

Total forecasted partner revenues at year 3 is PMX **8,215,934,933** ($513, 495,933USD).
10. Architecture

Block23 Cloud server includes several components which interact with each other in a service oriented way:

1. Ethereum
2. Blockchain CRM Platform
3. Health Network
4. Application Development Platform

The following diagram is showing these components, system users and main data flow between the components.
10.1 Ethereum

Ethereum is an open-source, public, Blockchain-based distributed computing platform featuring smart contract (scripting) functionality, which facilitates online contractual agreements. It provides a decentralized Turing-complete virtual machine, the Ethereum Virtual Machine (EVM), which can execute scripts using an international network of public nodes.

Block23 is utilizing Ethereum to create new digital currencies which can be used as Health points for the physicians. Creating a new digital currency using Ethereum involves creating a new smart contract and deploying it across Ethereum platform. Smart contracts are pieces of code that live on the Blockchain and execute commands exactly how they were told to. They can read other contracts, make decisions, send ether and execute other contracts. Contracts will exist and run as long as the whole network exists.

Here is an example of the simple contract that should be used to issue a digital currency.

```solidity
Contract token {
    Mapping (address => uint) public coinbalanceof;
    Event cointransfer(address sender, address receiver, uint amount);

    /* Initializes contract with initial supply tokens to the creator of the contract */
    Function token(uint supply) {
        Coinbalanceof[msg.sender] = supply;
    }

    /* Very simple trade function */
    Function sendcoin(address receiver, uint amount) returns(bool sufficient) {
        If (coinbalanceof[msg.sender] < amount) return false;
        Coinbalanceof[msg.sender] -= amount;
        Coinbalanceof[receiver] += amount;
        Cointransfer(msg.sender, receiver, amount);
        Return true;
    }
}
```

This is an example contract that generates 10 thousand tokens to the creator of the contract, and then allows anyone with enough balance to send it to others. These tokens are the minimum tradeable unit and cannot be subdivided, but for the final users could be presented as a 100 units sub dividable by 100 subunits, so owning a single token would represent having 0.01% of the total.

When new Health program is launched the Block23 Cloud Service generates contract automatically for the new Health points digital currency and deploys contact over Ethereum network using Ethereum JSON-RPC API.

JSON is a lightweight data-interchange format. It can represent numbers, strings, ordered sequences of values, and collections of name/value pairs. JSON-RPC is a stateless, light-weight remote procedure call (RPC) protocol. Primarily this specification defines several data
structures and the rules around their processing. It is transport agnostic in that the concepts can be used within the same process, over sockets, over HTTP, or in many various message passing environments. It uses JSON (RFC 4627) as data format. This interface gives Dapp’s access to the Ethereum Blockchain and functionality that the node provides, such as compiling smart contract code.

For each Person who is participating the Health program the personal account is created on the Smart Contract.

This account contains the following information:
- correct Person tokens balance;
- Person profile data items (encrypted and available for Person only);
- Person shareable profile data items (encrypted and available for SMI Profile Data Exchange Service);
- Person Sharing Options for the Profile Data Items.

The Person can configure Profile Data Sharing Options on his wallet (PMX).

There are the following Sharing Options can be set for the each level of the Profile Data hierarchy:
  a) Public
  b) Private
  c) Shareable for the reward

In case of option (c) Person also specifies the reward amount for sharing that data item.

After sharing People Profile it gets evaluated by the Block23 Scoring Engine and get a Quality Score assigned indicating how good and full is the profile data. This Quality Score helps Provider to select appropriate People Data Profiles for purchasing.

Research units/Health care providers and Developers are also provided with accounts on the tokens Smart Contract on Ethereum. Brand/Provider or Developer account contains data on the amount of tokens currently owned by the Brand/Provider or Developer. Brand/Health care providers or Developers can receive their initial amount of tokens from SMI.

All 3 parties (People, Research units, Developers) can trade tokens between each other for other crypto currencies or traditional currencies as well using existing crypto currency exchange infrastructure provided by Ethereum.


## 10.2 Blockchain for Health Care

### Data Processing
The Blockchain platform is a cloud service designed to collect and aggregate data on people. Each retailer is provided a dedicated workspace which is based on Hadoop architecture. Hadoop is a distributed data store that provides a platform for implementing powerful parallel processing frameworks. The reliability of this data store when it comes to storing massive volumes of data, coupled with its flexibility in running multiple processing frameworks.

Here are mainly five building blocks inside this runtime Hadoop envPMXnment (from bottom to top):

- The cluster is the set of host machines (nodes). Nodes may be partitioned in racks. This is the hardware part of the infrastructure.
- The YARN Infrastructure (Yet Another Resource Negotiator) is the framework responsible for providing the computational resources (e.g., cpus, memory, etc.) Needed for application executions.
- The HDFS Federation is the framework responsible for providing permanent, reliable and distributed storage. This is typically used for storing inputs and output (but not intermediate ones).
- Other alternative storage solutions. For instance, Amazon uses the Simple Storage Service (S3).

The mapreduce Framework is the software layer implementing the mapreduce paradigm The reliability of this data store when it comes to storing massive volumes of data, coupled with its flexibility in running multiple processing frameworks.

### Deep neural networks
Block23 CRM platform also includes tools for Person for automatic Person segmentation and discovering behavioral patterns based on intelligent processing of all data collected using different data mining techniques (hierarchical clustering, classification using SVM and ANN/DNN, decision trees, probabilistic networks).

The logic patterns are being extracted from the data using the Sequential Covering Algorithm. This algorithm is not required to generate a decision tree first. In this algorithm, each pattern extracted for a given class covers many of the data rows of that class. As per the general strategy the logic patterns are learned one at a time. For each time new pattern is learned, a data row covered by this pattern is removed and the process continues for the rest of the data rows. An example of pattern that can be extracted from data can be the following

\[ P_1: (\text{age} = \text{youth}) \land (\text{student} = \text{yes}) \land (\text{buys computer} = \text{yes}) \]

The following is the sequential learning algorithm where logic patterns are learned for one class at a time. When learning a pattern from a class \( C_i \), we want the pattern to cover all the data rows from class \( C_i \) only and no data row for any other class.
Algorithm: Sequential Covering

Input:
D, a data set class-labeled data rows,
Attvals, the set of all attributes and their possible values.

Output: A set of logic patterns.

Method:
Pattern_set={ }; // initial set of patterns learned is empty

For each class c do
    Repeat
        Pattern = Learn_One_Pattern(D, Att_vals, c);
        Remove data rows covered by Pattern from D;
        Until termination condition;
    Pattern_set=pattern_set+pattern; // add a new pattern to pattern_set
End for
Return pattern_set;

After the initial process of learning patterns is finished it is required to prune the learned pattern-set. The Assessment of quality is made on the original set of training data. The pattern may perform well on training data but less well on subsequent data. That's why pattern pruning is required.

The pattern is pruned by removing conjunct. The pattern R is pruned, if pruned version of R has greater quality than what was assessed on an independent set of data rows.

FOIL is one of the simple and effective methods for pruning. For a given pattern P, FOIL_Prune = pos - neg / pos + neg where pos and neg is the number of positive data rows covered by P, respectively.

This value will increase with the accuracy of P on the pruning set. Hence, if the FOIL_Prune value is higher for the pruned version of P, then we prune P.

Once all data which available on people is aggregated it can be analyzed using dashboard which are assembled out of over 25 different types of customizable visualization components.

The application’s visual controls enables users to rapidly view the data the way they want and challenges the established methods of BI solutions that are typically rigid in the level of information detail and the ways users can navigate.

Together with highly interactive capabilities, users can quickly and easily see patterns, trends, and unforeseen relationships and dependencies in their data – and as a result, users are able to draw insight, inferences, and conclusions that improve performance and provide a competitive advantage.

**Block23 Individual Profile Data Exchange Service**

The Block23 Individual Profile Data Exchange service is a software component which is the part of the CRM Platform that performs the following functionality:

- collect data on all people participating Health program in a single registry, each people record on the registry contains link to the people digital wallet (PMX);
- collect data on people Profile Data Sharing Options (which Profile Data Items for the people can be shared for the token reward);
- Evaluate People Data Profile and assigning Quality Score to each People profile;
- Provide Research units/Health care providers with the UI to find relevant people and purchase Profile Data Items from chosen people based on Quality Score and data items available.
When Brand/Provider puts a request to purchase People Profile Data with the help of Block23 Individual Profile Data Exchange service the following process is launched:

1. The Provider makes a Purchase request on the Block23 Individual Profile Data Exchange service;
2. The Block23 Individual Profile Data Exchange service builds a list of token transfer transactions for all the token payments the Provider needs to do for each of the selected People;
3. The Provider approves all the token transfer transactions and they get executed on the blockchain;
4. After token transfer transaction is executed for the People the SMI Individual Profile Data Exchange service grants the Provider access to the purchased shared data of this People.

10.3 Health Loyalty Network

The Health Network component is configured by the Provider to track Person purchases and execute a Health rewards program.

When a deposit tokens based on a specific Person event is triggered, the Health Network component uses Ethereum JSON RPC call to execute sendcoin function and make a transfer of points to the Person wallet.

The Health network component is a dedicated web service targeted to collect data on people purchases from stores. There are 2 ways supported to collect purchase data:

- Online
- Offline.

In case of an online scenario, a small add-in to a store POS system is installed that allows POS to report using a REST Web call to the BLOCK23 Cloud Service and provide information on the purchase transaction. Ready to plug-ins to POS terminal manufacturers such as NCR and Toshiba will be developed and available to POS manufacturers to install, thereby enabling a seamless BLOCK23 Health Network integration for physicians.

In case of an offline scenario, the Health web service has certain channels to receive transactions file from the retailer’s analytical software on a periodical basis (e.g. Once a day or once a week or on custom schedule).

In both scenarios, when purchase transaction data is received, the Health network component confirms transactions to trigger a deposit of Health tokens according to the Health reward offered by the retailer. In order for this action to take place, the Ethereum JSON RPC library is used to execute sendcoin function and make a transfer of tokens to the Person wallet.

Together with tokens transfer the Person purchase information is also put into the Person wallet using encryption in order to update Person purchase history/brand preferences data.

10.4 Ethereum Scalability Issues

The current implementation of the Ethereum Blockchain is suffering from scalability and performance issues. There is a limited capacity of the Blockchain in terms of how many transactions can be processed per second by the network. Although, there are plans for
improving Ethereum transaction processing times, scalability issues may limit the possibilities of BLOCK23 token circulation between people, health care providers and other parties.

In order to prevent potential scalability issues most of the BLOCK23 token transactions will be partially executed off-chain with a solution for security token transfers between parties without involving Ethereum Blockchain to execute a transaction.

**Payment Channels Technology**

The Payment Channels Technology will be used in events that the Ethereum platform is unable to handle the required number of transactions. The Payment Channel is a smart contract which is established between two parties for the purpose of making BLOCK23 direct token transfers to each other.

When a payment channel is created each party is depositing some tokens in a payment channel contract. Then, transfers can be performed by sending signed messages directly between two parties without any involvement of the Blockchain itself within the deposited limit. Therefore, transaction frequency is only limited by the hardware of the sender and receiver and communication channel limits.

Additionally, there are no transaction fees other than for a one-time on-chain deposit and eventual settlement. Payment channels can be established between any two BLOCK23 token users building an interconnected BLOCK23 payment channel network. This kind of network allows executing token transfers between two parties on the network even if they don't have a direct payment channel established between them. In this case payment routing is implemented to route the off-chain payment between two parties by finding a suitable payment channel path across the network (e.g. the diagram below showing payment path from Provider 1 to People 4.)
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