

Aladdin Blockchain Technologies

Initiation of coverage

A whole new world

Software & comp services

15 June 2018

Price €28.0

Market cap €321m

Net cash (€m) at 31 December 2017 6.4

Shares in issue 11.45m

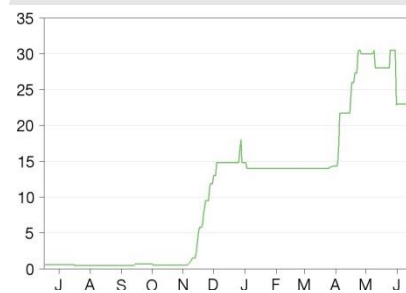
Free float 55%

Code NMI

Primary exchange Düsseldorf

Secondary exchange N/A

Share price performance



52-week high/low €30.5 €0.4

Business description

Aladdin is an early-stage healthcare software company. The company intends to leverage novel technologies including blockchain, big data and AI to create a healthcare ecosystem to improve efficiency, security and patient outcomes. Aladdin's users are currently based in China, although we expect the business to grow internationally over the coming 12 months.

Next events

H118 results September 2018

Analysts

Katherine Thompson +44 (0)20 3077 5730

Alasdair Young +44 (0)20 3077 5700

tech@edisongroup.com

[Edison profile page](#)

Aladdin Blockchain Technologies is a research client of Edison Investment Research Limited

Aladdin Blockchain Technologies (Aladdin) is an early-stage software company seeking to use big data, blockchain, artificial intelligence (AI) and machine-learning technologies to improve preventative medicine and the efficiency of delivering healthcare. Although the long-term goal is to be a big data analytics play, the shorter-term focus is on developing applications to build a healthcare ecosystem in order to gain access to patient data. Aladdin's first operations are in China, it has just announced entry into the Indian healthcare market and it plans to expand into other Asian markets.

Year end	Revenue (€m)	PBT* (€m)	EPS* (€)	DPS (€)	P/E (x)	Yield (%)
12/17	0	(0.02)	N/A	0	N/A	N/A

Note: *PBT and EPS are normalised, excluding amortisation of acquired intangibles, exceptional items and share-based payments.

Putting control in the hands of patients

Aladdin's first app, recently launched in China, supports patient record-sharing and medical appointment booking. By giving patients control over who can see their records, Aladdin aims to improve the efficiency of diagnosis and treatment. The app is also designed to encourage patients to engage with their treatment plans and make lifestyle improvements to benefit their health. Through the use of this app, Aladdin expects to gain access to a large volume of patient records.

Using blockchain to improve efficiency and security

Aladdin is developing blockchain technology to help healthcare providers and insurers to work together more efficiently. The first application to provide an audit trail for records access is due for launch imminently. The creation of a number of blockchain consortia should help the development of the healthcare ecosystem.

Analysing large datasets to support healthcare R&D

The company is developing AI and machine-learning tools to create an analytics-as-a-service offering. If a sufficient number of hospitals sign up to use the Aladdin app, the company should have access to large quantities of health and lifestyle data that could be anonymised and analysed to identify trends, which could result in new treatments and improvements in preventative healthcare.

Early-stage business

Aladdin is a very early-stage company with limited operating history; hence, we are not in a position to provide forecasts or a valuation. The company has various proposed monetisation routes, but we highlight that at this stage in the company's life, flexibility will be key to maximising opportunities. The wider launch of the app, followed by hospitals and patients signing up to use it, will be the first indicators that the company's strategy is on track. To finance its growth plans, the company is targeting a fund-raise in H218.

Investment summary

Building a healthcare ecosystem

Aladdin is an early-stage software company developing technology for the healthcare market. The company's ultimate goal is to improve health outcomes through insights gained from the analysis of large volumes of health and lifestyle data, and the provision of technology to help patients to manage their own health. It is also developing technology to assist healthcare-related organisations operate as efficiently and cost-effectively as possible. The company wants to build a healthcare ecosystem made up of patients, healthcare providers, insurers and pharmaceutical companies, where various technologies will help the participants work more efficiently together while putting control in the hands of patients to take charge of their own health.

The path to user adoption

The company is at an early-stage of this process – in this report, we outline the key steps that the company is taking to develop and launch various applications. It has already soft-launched its record-sharing and appointment-booking app in China, and is working towards a wider launch of the app. Signing up hospitals to use the app will be the first step to gaining patient users of the app and will be the initial route to accessing meaningful numbers of patient records. Once a critical mass of app users has been reached, the company expects to launch a marketplace, where patients can access healthcare-related products and services. The launch of the first blockchain audit trail app should be a good demonstration of how distributed ledger technology can be used within healthcare, and pave the way for other applications that could increase the efficiency of hospital operations. As more hospitals and patients join the ecosystem, Aladdin will have access to growing volumes of healthcare and lifestyle data. Analysis of this data, either by Aladdin or by third parties, has the potential to uncover patterns or trends that can be used to develop better treatments or inform preventative medicine.

Early-stage business – track milestones

The company is at such an early stage in its development that we are not in a position to provide forecasts. The company closed FY17 with a cash balance of €6.4m, and is targeting a fund-raise in H218 to fund its growth plans. Monetisation of the technology is likely to include, but is not limited to, licence fees for the app, commission fees from sales in the marketplace, analytics-as-a-service fees and blockchain-as-a-service subscriptions. Key milestones and data points that we will track to assess progress include: full launch of the app in China; number of app users (patients and hospitals); number of patient records transferred; launch of the first blockchain consortium; launch of the marketplace in China; and launch of the alpha version of the blockchain-as-a-service tool. In the longer term, we expect to see announcements of partnerships in other geographies and development of AI and machine-learning tools to analyse the data.

Sensitivities: Early stage, regulation, funding, competition

Aladdin's progress will be sensitive to a number of factors, including competition, data privacy and security regulations, the ability to develop and launch the various proposed technology applications, user adoption, the availability of funding and the relationship with Elemental Concept, its outsourced development company. The company has several proposed monetisation routes, but we highlight that at this stage in the company's life, flexibility will be key to maximising opportunities.

Company description: Building a healthcare ecosystem

Aladdin is an early-stage company operating in the healthcare software market. The company is developing a variety of software applications with the aim of improving the efficiency and security of the healthcare market and longer-term, using data analysis to produce insights to improve health. Technologies being developed include a record-sharing app, blockchain applications, AI and machine-learning tools and analytics-as-a-service. The company is focused on the largest healthcare markets in terms of patient numbers – China and India – where access to a substantial number of healthcare records should provide a large pool of data.

Background

Aladdin was founded in 2017 by Wade Smith. In November 2017, the company reversed into AE New Media Innovations SE on the Düsseldorf Stock Exchange at €5.4 per share. In December 2017, the company placed 1.15m shares at €5.4 per share, raising gross proceeds of €6.2m.

Company vision – a healthcare ecosystem

Aladdin's ultimate aim is to create a healthcare ecosystem whereby patients, healthcare providers, insurers and pharmaceutical companies can share data and transact with each other in a more cost and time effective manner than is currently the case. The company will initially roll out software applications to the first two categories of stakeholders: individuals and healthcare providers. After adoption by these parties reaches critical mass, Aladdin plans to monetise the ecosystem by opening it up to the insurers and pharma companies – we expect these types of businesses will be keen to either access pools of data directly or gain health-related insights from Aladdin's analysis of relevant pools of data.

Company strategy

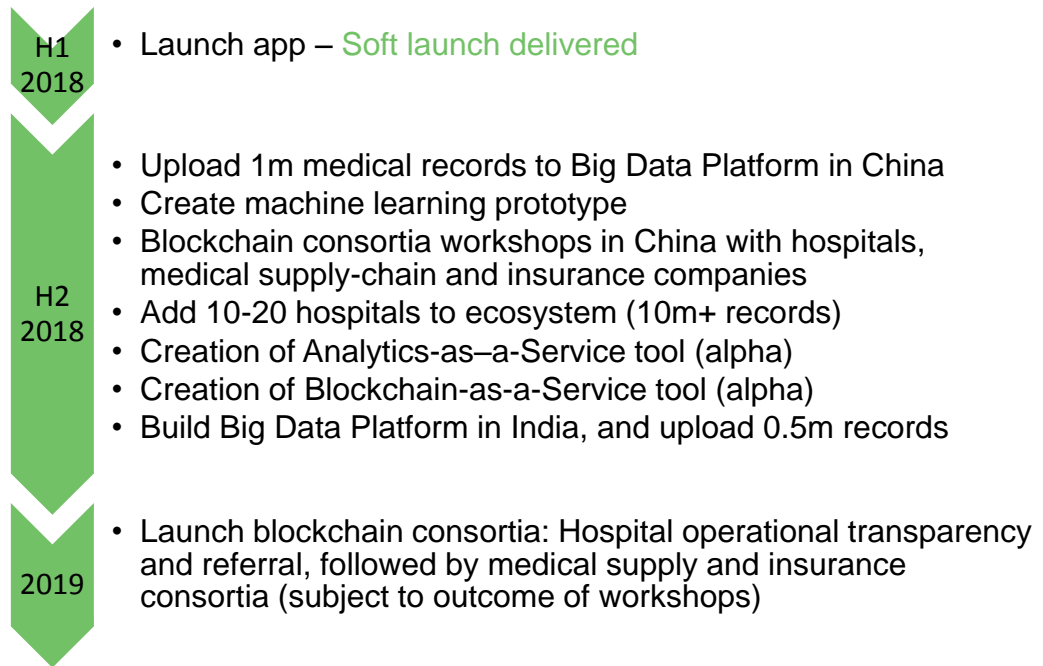
The strategy will follow a multi-stage process:

1. develop and launch a record-sharing and appointment-booking app for clinicians, hospital administrators and patients;
2. populate big-data platform with patient health and lifestyle data (ongoing);
3. build healthcare-related blockchain applications;
4. develop healthcare ecosystem to include hospitals, clinics, patients, insurance companies, pharmaceutical businesses, government organisations and wellness-related businesses;
5. launch marketplace;
6. encourage users to transact via the ecosystem eg make and pay for appointments, buy insurance, make insurance claims, buy drugs, buy/sell anonymised patient data. Develop a loyalty scheme as the means of payment/incentivisation; and
7. use AI and machine learning to analyse data.

Geographically, the company is initially targeting China and India. Longer-term, the company would like to expand into other Asian markets, including Singapore, the Philippines and Indonesia.

In the diagram below, we summarise the key milestones the company is targeting over the next 12–24 months.

Exhibit 1: Near-term company milestones

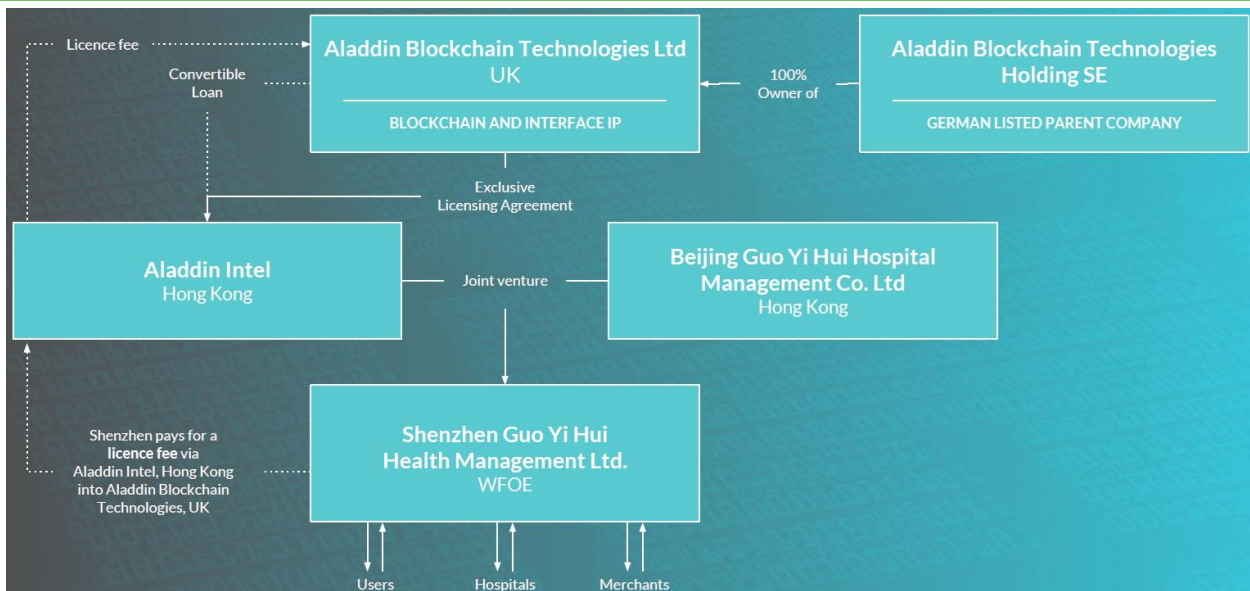


Source: Aladdin Blockchain Technologies, Edison Investment Research

Company structure

The corporate structure is displayed in Exhibit 2.

Exhibit 2: Summary of company holding structure



Source: Aladdin Blockchain Technologies

The listed parent entity is Aladdin Blockchain Technologies Holding SE, which owns the entirety of the UK-based subsidiary named Aladdin Blockchain Technologies Ltd. This subsidiary will derive revenues via an independent Hong Kong-based company called Aladdin Intel (to whom the parent company has provided a convertible loan). In turn, Aladdin Intel has a joint venture (JV) with the Beijing Guo Yi Hui Hospital Management company, the hospital group that will provide the initial batch of patient records. It is this JV (called Shenzhen Guo Yi Hui Health Management) that will generate revenues via app subscription fees and a healthcare marketplace. Other revenue

streams, such as the monetisation of data analytics, will flow straight to Aladdin Intel. The proportion of revenues which flow through to the UK subsidiary (and the parent) depends on the revenue stream in question, but ranges from 7.5% to 100% (see page 13 for further details).

The Aladdin healthcare app

The company has developed an app that will enable doctors, hospital administrators and patients to view and amend healthcare records. Patients will be able to set controls on who can access their records. As a patient will typically see a variety of doctors at various institutions over their lifetime, there will be a number of patient records held by each institution. The more records a patient has access to, the easier it is for different doctors to get access to records made by other doctors that are relevant to the patient's treatment.

The patient-facing app will allow patients to book appointments, upload/download medical records and search for doctors. The doctor and hospital administrator versions will show appointment bookings and enable access to medical records. In due course, the functionality to add lifestyle data, such as Fitbit integration, will be added and the app will focus on improving a patient's engagement with their treatment plan.

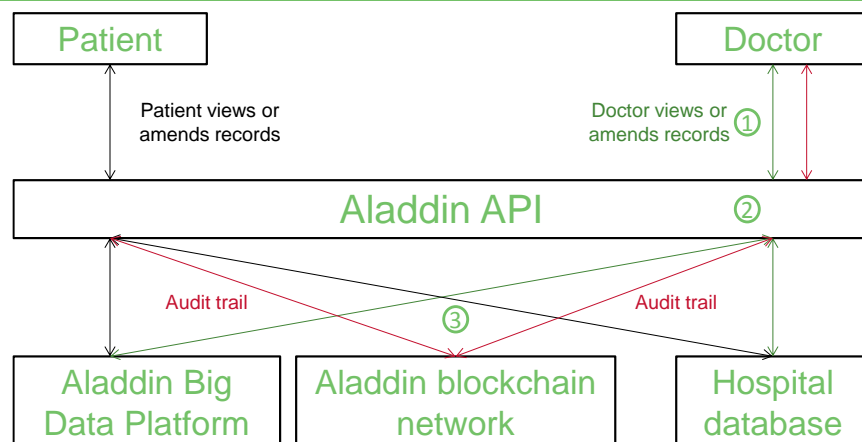
Aladdin is also developing a merchant website, which will host a marketplace for access to approved regulated medical products and services.

Launching in China

The Shenzhen Guo Yi Hui JV (Shenzhen GYH) has soft-launched the apps for patients, doctors and hospital administrators. In anticipation of the app launch, two initial hospitals have signed up and have agreed to transfer a copy of their patient records to a big data platform (BDP) set up in China by the JV. The hospitals, with roughly one million patients, will initially transfer 1m records¹. Note that each hospital will still legally need to hold a copy of their patient records, so the BDP will hold duplicate records.

Exhibit 3 shows the expected data flows between the Aladdin BDP, the doctor, the patient and the hospital's records. This clarifies how the company will ensure that the data on the BDP matches the data in the hospital's own records.

Exhibit 3: Process flows for doctor and patient access to records



Source: Edison Investment Research

¹ Note that one patient will generate multiple records across different hospitals and clinics, so patient numbers will not equal the number of patient records.

Data flows are as follows:

1. Doctor calls patient records via the Aladdin API, which connects to both the hospital database and the Aladdin big data platform.
2. Doctor modifies/updates the patient's records. The Aladdin API applies the changes to both the hospital database and the Aladdin big data platform.
3. The blockchain logs all views and modifications the doctor makes to the records.

Exhibit 4 shows the types of data the company expects to collect in the big data platform.

Exhibit 4: Data types			
Health condition data	Interventions data	Behavioural data	Population segments data
Medical history	Medical interventions	Physical activities	Demographic
Diagnoses	Non-clinical interventions	Dietary & hydration habits	Socio-economic
Physical diagnostics	Allied health interventions	Sleep	Climate/geographic
Genetics			
Source: Aladdin			

Once the app is fully launched, we would expect other hospitals in the Beijing Guo Yi Hui Hospital Management group to sign up. We understand the group comprises 40 private hospitals and clinics with roughly 30 million patients and the company is targeting 10–20 of these signing up by the year end. According to the company, this would result in another 10m patient records being added.

Healthcare system in China

The provision of healthcare in China is highly fragmented, and the regulatory landscape is changing rapidly. While the vast majority of citizens (c 97%) are covered by some form of public healthcare insurance, individuals must pay for treatment up front, before claiming reimbursement afterwards. Even then, reimbursement rates typically range from 50–75% of the total charges incurred (Yu, 2015², Hu and Mossialos 2016³), leaving patients out of pocket. Furthermore, this exposes individuals with lower disposable income to the risk that they cannot afford the upfront costs for the provision of healthcare. To make up for this shortfall, household saving levels are the highest in the world at c 38% (OECD, 2014). The quality of both care and reimbursement rates is also highly disparate when comparing different provinces. In general, urban centres enjoy much higher standards of care, with improved levels of cover to match, relative to the rural population.

In order to combat the high variability in cost and quality of healthcare (and the lower consumer expenditure on other goods and services as a result), the Chinese government is actively reorganising and upgrading the healthcare system. The 'Healthy China 2020' initiative is a recent demonstration of this. Furthermore, in March 2018, the government announced that a number of healthcare agencies would be reorganised and amalgamated into a larger regulatory body. Overall, the general direction of travel is towards centralisation, streamlining and standardisation of the sector - factors that should lend themselves to Aladdin's ecosystem.

Entering the Indian market

The company has just announced that Aladdin Blockchain Technologies (the UK entity) has signed an agreement with OurHealthMate India. OurHealthMate (OHM) was set up to help ex-pat Indians to organise and pay for medical treatment for family members living in India. It has developed into a marketplace partnered with 30,000 doctors in India. OHM only works with and provides appointments with accredited healthcare providers, to offer a safe and reliable service in a market where many fake doctors exist.

² Yu H (2015) Universal health insurance coverage for 1.3 billion people: What accounts for China's success? Health Pol. 119, 1145-1152.

³ Hu J and Mossialos E (2016) Pharmaceutical pricing and reimbursement in China: When the whole is less than the sum of its parts. Health Pol. 120, 519-534.

In H218, Aladdin and OHM will start phase 1 of the agreement, whereby Aladdin will establish a big data platform for the medical records of Indian patients. Aladdin and OHM will work together to facilitate the collection of medical data within the Indian market, starting with 500,000 medical records in H218, rising up to five million patient records by the end of 2020. Aladdin plans to use AI and machine learning techniques to analyse the data with the aim of enabling early detection and prevention of chronic diseases in India.

Also as part of the agreement, Aladdin will design a blockchain application for the Indian healthcare market and both partners will look to build a healthcare ecosystem that encompasses hospitals, insurers, pharmaceutical companies and healthcare institutions.

Haoma: Healthcare-related blockchain technologies

The company intends to develop and launch the Haoma ecosystem which will offer a number of healthcare-related blockchain apps. As opposed to mining-based blockchains typically used for cryptocurrencies, Aladdin intends to use a permissioned blockchain – this means that only those entities that are deemed legitimate are allowed to join the network. Legitimacy will be determined by the blockchain consortium, though Aladdin will initially control this process itself. The distributed nature of a blockchain network means that each node (or ledger) will have a complete record of all transactions undertaken by network participants, removing the need for a centralised authority to administer the data. To ensure all nodes have the same record of transactions, a consensus mechanism is used to agree on the one version of the truth. Aladdin uses Hyperledger blockchain technology, which we describe in more depth below.

Healthcare record access audit trail

The first network will create an audit trail for patient medical records in China, documenting when a record is accessed or amended, who by and from where. The target launch date for this app is July, starting with three nodes: Aladdin and the two pilot hospitals. We expect other hospitals from the Beijing Guo Yi Hui Hospital Management group to join in due course.

How it works

Any view of or amendment to records on the BDP will trigger a smart contract.⁴ This will add the audit event information to the appropriate hospital node. Once approved, the audit event will be broadcast to all nodes to commit the transaction to the blockchain network, ie not the actual data but detail about who/when/how/what accessed/appended. Hospital administrators and doctors will be able to view the medical record audit trail; patients will not have this access, although they could request that it is checked if they are concerned that unauthorised access has taken place.

Scaling up – introducing Zurvan

Currently, adding a new node to a pre-existing blockchain network is a heavily manual process. It essentially involves shutting down the network (during which time no records would be processed), modifying the underlying architecture to include a new node, and restarting the system. The company is developing Zurvan, its own blockchain-as-a-service tool, for which it is aiming to have an alpha version by the end of the year. Zurvan will consist of a proprietary blockchain consortium management tool as well as an orchestration tool. This would enable any entity to easily join an Aladdin-managed blockchain network and to begin to transact immediately. Initially, Aladdin will

⁴ A smart contract is a piece of computer code that is capable of monitoring, executing, and enforcing an agreement in a distributed ledger ecosystem. This works via an 'if...then...' process where the "ifs" can be seen as predetermined clauses in a contract (such as terms of delivery/ changes to a data platform), which must be completed before executing the 'then' element (such as payments/ logging the changes).

decide who can join the consortium, but once it is fully up and running, the consortium itself will decide who is able to join the network and host a node.

Aladdin's blockchain based on Hyperledger architecture

Hosted by the Linux Foundation, the Hyperledger project is a collection of open source distributed ledger technologies (DLT). Members of the project include established technology companies (eg Cisco, IBM, Intel and SAP), banks (eg J.P. Morgan, Wells Fargo, BNY Mellon) and a range of DLT specialists such as R3 and ConsenSys. The umbrella organisation aims to develop DLT collaboratively, with a view to improving both performance and adoption of the technology.

Hyperledger Fabric

The Aladdin blockchain is built on the most developed of these projects, Hyperledger Fabric. Originally contributed by IBM and Digital Asset, Fabric is a permissioned (private) blockchain architecture, meaning that prospective network participants must be given access by a central authority before they join the network. This contrasts with most blockchain ecosystems, most notably Bitcoin and similar cryptocurrencies, which operate completely open blockchain architectures, which enable unknown identities to both transact with each other and contribute to the maintenance of the information stored within the ledger.

The platform is modular, meaning that users can bolt-on additional functionalities, either through their own internal development, or via additional open-source code. Smart contracts are one of the key functionalities of the architecture. These are triggered when a change happens outside of the blockchain (for example, in Aladdin's BDP or API), causing corresponding updates to the ledger.

As a result, Fabric is highly customisable, providing optionality for levels of privacy (how much transaction information is available to the public or other network participants), and even how consensus is formed. Of these consensus mechanisms, Practical Byzantine Fault Tolerance (PBFT) is the most common, and it is this method that Aladdin uses. PBFT is where each node maintains its own internal ledger of past events, and modifies this ledger upon receipt of new information. The node then shares the outcome of the modification with all other nodes for comparison. Consensus is then achieved as each node votes for the version of events that they calculated, with the most voted outcome being committed to the blockchain.

The level of customisation available has contributed to the uptake of Fabric across the ecosystem. Well publicised examples using the Fabric framework include the London Stock Exchange piloting its use to maintain shareholder records for unlisted small companies in Italy, a Royal Bank of Canada scheme to use the technology for cross-border interbank settlements between Canada and the US, and Maersk (with IBM) improving the efficiency of supply-chains.

Of the other Hyperledger frameworks, Sawtooth (contributed by Intel) is of potential interest to Aladdin, as the Proof of Elapsed Time consensus mechanism is arguably less CPU intensive, which could help the scalability of the network in the future. However, Fabric currently has higher levels of adoption and development, and provides all the functionality currently required by Aladdin.

Future blockchain apps to improve security and efficiency

Once the audit blockchain network has been launched, the company expects to host a series of workshops with hospitals, supply chain partners and insurance companies in China to discuss their needs and to finalise development plans for other healthcare blockchain networks. The company intends to launch four blockchain consortia within the Haoma ecosystem in 2019:

- hospital operational transparency, eg charging between hospitals
- hospital referrals, eg from primary care to a specialist

- medical supply chain, eg this could track pharmaceutical products from manufacture to dispensing, to ensure that counterfeit drugs do not make their way into the supply chain
- health insurance

Longer-term goal: Data analysis

The company's long-term goal is to make use of the large quantities of health and lifestyle-related data stored in patient healthcare records. With a population of 1.4bn, the company's initial focus on China gives it the potential to access a large number of records. The company will either sell the data to third parties (insurers, pharmaceutical companies) or offer analytics-as-a-service to undertake its own analysis of anonymised data using AI and machine learning to identify patterns and trends.

In particular, the company is aiming to build the world's largest structured diabetes and pre-diabetes data repository. Treating diabetic patients takes up a material percentage of national healthcare budgets even though in many cases, Type 2 diabetes is avoidable. Through analysis of its database, Aladdin hopes to be able to generate insights that could help in the prevention and treatment of the disease.

Data security key to trust in the system

Data security and privacy regulations in the respective countries will influence how the data can be used. We expect that consumers will need to consent to their data being used.

The company has taken several steps to ensure that data is held and processed in a secure manner. The big data platform uses a HIPAA⁵-compliant Cloudera-based data storage platform. The company has implemented HIPAA best practice controls for all technology components of the system, including user interfaces and server-side software and databases. The company is targeting being ISO27001 certified by November – this is the international standard that describes best practice for information security management system.

Competitive environment

The provision of healthcare is being modernised rapidly in Aladdin's target markets and across the world in general. Along with the improvement in quality of care and of medical facilities, technology is increasingly being seen as a tool to improve the efficiency of healthcare provision, with a view to both reducing costs and improving patient outcomes. As such, there are innumerable technology companies attempting to address this challenge. In China for example, an estimated 2,000 healthcare apps are currently available, including offerings from tech heavyweights Tencent, Baidu and Alibaba.

The areas in which Aladdin is developing technology include the following types of applications:

- **Medical treatment-related:** this includes online booking of face-to-face appointments, online video appointments with doctors and online AI-based diagnosis
- **Blockchain-related:** in some cases linked to crypto-coins
- **Online healthcare marketplaces**
- **Record sharing apps**
- **Big data analysis:** analysing data held in healthcare records to gain insights into conditions and develop treatments and preventative medicine. Includes applying AI and machine-learning

⁵ Health Insurance Portability and Accountability Act of 1996, US legislation.

techniques. Also includes training AI to undertake image analysis of scans to improve the speed and accuracy of diagnosis.

Chinese tech competition

Perhaps the most direct competition in China comes from listed firm **Ping An Good Doctor**, which listed on the Hong Kong Stock Exchange in April 2018 at a valuation of c HK\$58bn (\$7.5bn). Launched in 2015, Good Doctor is currently China's largest online healthcare platform by number of users, with 193m registered users at end 2017. The app provides free appointment booking, in addition to diagnosis and treatment, and patients can communicate with healthcare practitioners via text, photos and video. The company has launched an online marketplace that sells healthcare products and services and has started to use machine learning and AI to improve patient outcomes. The parent company, Ping An, is the second largest insurer in China and was also the first Chinese member of R3's global distributed ledger consortium. The platform generated c \$275m revenues in 2017, via online consultations, the provision of value-added services to insurance companies and other third-party vendors, advertising and direct sales of healthcare products.

Tencent's **WeChat Intelligent Healthcare** offering lets users book appointments and make payments to healthcare providers via the instant messaging app. The most recent statistics point to 110m users and 38,000 medical facilities connected with WeChat. Tencent also has a pilot where a user's mobile health data (such as the step counter on WeChat) will influence that individual's insurance premiums, whilst also providing monetary bonuses. The service has c 10m users in the pilot. In 2017, Tencent launched its AI Medical Innovation System (AIMIS) which diagnoses endoscopic images in seconds via comparisons with its database of over one billion images.

Alibaba's (listed) subsidiary **Ali Health** is using blockchain technology to reconcile the medical records of hospitals and health centres in Changzhou. The system will also provide traceability of changes, in addition to tamper resistance. Whilst this program is in its infancy, the bulk of Ali Health's business (and its c \$9.6bn valuation) relates to medical e-commerce and product tracing. It has a number of relationships with multinational pharmaceutical companies including GSK, AstraZeneca and Sanofi.

Baidu Doctor is a healthcare app for booking appointments and communicating directly with doctors. The company has also launched Melody, an AI-based solution which integrates with Baidu Doctor. Melody asks the patient a series of questions to narrow down the diagnosis, before referring the patient to a doctor or recommending a course of treatment.

Blockchain specialists

With regards to using blockchain for healthcare applications, private companies MedRec, Grapevine and Medicalchain are amongst the most established. **MedRec** is based on the Ethereum blockchain and lets patients share their data with healthcare providers via smart contracts, giving them a cryptographic record of who has had access to their medical records. Like Aladdin, London-based start-up **Medicalchain** is also using Hyperledger Fabric to let patients grant access to (and track views and modifications to) their data to doctors, hospitals, laboratories and insurers. The company is also launching a cryptotoken, 'MedTokens', which can be spent within the ecosystem on insurance payments or healthcare products. The company will launch a trial phase with four GP practices in the UK in July 2018, which will include 30,000 registered patients. **Grapevine** aims to use blockchain to create a standardised data exchange, particularly for electronic healthcare records, but also for other sectors including education, finance and energy. The company is also launching an ICO (initial coin offering) in the summer of 2018, which will facilitate marketplace transactions. We understand that Grapevine is currently targeting Western Europe and the US. **Patientory** is a US-based healthcare technology start-up which aims to connect doctors, care providers and patients to access, store and transfer healthcare data on the same platform. The

company will disaggregate healthcare records, meaning that only users with the appropriate access key can recall the data for viewing or sharing. The company held an ICO for the PTOY coin (based on Ethereum), which facilitates payments between community members, and currently has a market cap of c \$5m.

Other competition

In the UK, **Babylon Healthcare** has an NHS-backed app which provides users with a range of features including appointment bookings, remote consultations (including the dispensing of prescriptions) and an AI service which enables users to send symptoms to the app, which will respond with AI-generated healthcare advice. As of April 2018, Babylon also has a partnership with Tencent in China to roll this AI solution out via the WeChat messaging service. The company is in the process of rolling out offerings in the US and the Middle-East and has raised c \$85m to date.

Flatiron Health provides a platform which aggregates both structured and unstructured oncology data from a wide variety of sources. Data interrogation via its own analytics engine provides actionable insights to assist cancer researchers and care providers to improve patient outcomes. Flatiron was acquired by Roche for \$1.9bn in February 2018.

While not specific to healthcare applications, there are also numerous **big data analytics** (and AI) providers who are significantly more established than Aladdin. The likes of IBM, Microsoft, SAP, Oracle, VMware and DeepMind are all circling this space, and all of these names have annual R&D budgets orders of magnitude greater than Aladdin. We note that while Aladdin is not in direct competition with these companies, we would expect the overlaps to grow over time as Aladdin expands the size of its data platform. It is possible that Aladdin will apply external expertise to the data it collects as opposed developing every aspect of this functionality itself.

Exhibit 5: Summary of competitive landscape

Peer	Corporate info		Functionalities								KPIs
	Market cap	Money raised	Doctor consultancy			Healthcare record			Marketplace	Using DLT?	Estimated users (m)
			Booking app	Video conferencing	AI diagnosis	Aggregation	Audit trail	Sharing			
Aladdin		7.3	Y	N	N	Y	Y	Y	Planned	Y	
Ping An Good Doctor	7,500	2,000	Y	Y	Y			Y	Y	Planned	193
WeChat Intelligent Healthcare			Y		Y			Y			110
Ali Health	9,600					Y	Y	Y	Y	Y	
Baidu Doctor			Y	Y	Y						
Flatiron Health	1,900*	313			Y	Y		Y			
MedRec	N/A						Y	Y	Y	Y	
Medicalchain	N/A	24					Y	Y	Planned	Y	0.03
Grapevine	N/A					Y		Y	Planned	Y	
Patientory	N/A	7.2				Y		Y	Planned	Y	
Babylon Health	N/A	85	Y	Y	Y			Y			1

Source: Edison Investment Research. Note: Flatiron Health was acquired by Roche for \$1.9bn.

Summary

There is evidently a wide array of companies operating in many of the same verticals as Aladdin. The mobile appointment bookings market appears particularly crowded, while there are a number of larger, established companies linking medical (or fitness) data to insurance. However, few seek to aggregate healthcare records from different sources, create a log of views and modifications of these records and selectively share this data with the various stakeholders within the healthcare ecosystem. Furthermore, of the dedicated blockchain companies in the field, there appears to be limited overlap with Aladdin in terms of target markets. As a result, while there is a strong competitive landscape for individual solutions, there is little direct competition when assessing the entire ecosystem that Aladdin intends to build.

Management

The Aladdin management team combines experience of doing business in China, India, Russia and Singapore with software development and investing in private companies.

- **CEO and chairman:** Wade Smith has 16 years of emerging markets and entrepreneur direct private investment experience in Russia and China. He has built, invested and sold multiple technology and internet businesses in both of these markets.
- **COO and deputy chairman:** Bimal Shah has extensive experience from start-ups to multi-nationals, enabling digital solutions, business transformation and bringing existing companies into the digital world by creating new solutions with technology. Bimal is a CA, and CEO and co-founder of software developer and consultancy Elemental Concept.
- **CTO:** Philip Jacobs has 15 years' experience in creating agile teams, with a focus on software development, infrastructure, business intelligence, operational support to transform businesses with digital solutions. He has a PhD in mathematical modelling and started his career in the investment banking industry.
- **Head of blockchain:** Paul Sitoh has over 10 years of development experience from mobile to backend systems. Paul has led the delivery of two Hyperledger Fabric-based projects for the finance industry and is at the forefront of blockchain technology. Paul has previously worked at companies including IBM and Monitise.
- **Chief scientist:** Fenglian Xu is an award-winning innovator and inventor with more than 30 patented solutions to her name. She has extensive experience in AI, blockchain technology and medical image processing.
- **Head of data science:** Zhangming Niu has 10 years' experience in designing and managing cloud computing and big data products for governments, companies, universities and research institutions.

We note that all of the management team, bar Wade, are also employed by Elemental Concept.

Sensitivities

The company's financial performance and valuation will be sensitive to the following factors:

- **Number of hospitals that sign up:** The value that can be extracted from the data pool that Aladdin collects will grow as more data are added to the platform. For the higher value revenue streams (eg data analysis for governments/pharma/insurers), it is likely that Aladdin will have to gain access to a minimum quantity of data to draw meaningful, statistically significant inferences.
- **Ability to charge for use of app:** The level of monetisation from the app will depend on how much utility end users ascribe to its usage. It is possible that patient users would be unwilling to pay for usage, in which case Aladdin would need to seek payment from hospitals instead.
- **Volume of sales on marketplace:** The size and volume of transactions (as well as Aladdin's cut) will influence Aladdin's revenue streams.
- **Data protection and privacy regulations:** Aladdin will have access to and control over a huge volume of sensitive, personal data. Should Aladdin suffer a data breach, it could significantly impair the company's ability to gain access to additional users, be it patients or other consortium members. While current regulatory trends appear favourable, a regulatory tightening with regards to healthcare data privacy and sharing could influence Aladdin's growth trajectory.

- **Ability to build technology:** Blockchain is a nascent technology with few operational real-world instances. Aladdin is also developing other technologies, including the record-sharing apps, data analytics tools and artificial intelligence and machine-learning algorithms. As such, there is a certain amount of execution risk.
- **Availability of funding:** As at the end of FY17, Aladdin had €6.4m cash. The company has stated that it is targeting a fund-raise in H218.
- **Related party conflict:** Aladdin outsources all development work to Elemental Concept, which was co-founded by Bimal Shah, Aladdin's COO. As such, there is a potential conflict of interest with regards to the favourability of payments from Aladdin to Elemental. Furthermore, should this relationship break down, Aladdin would lose its entire development capacity. However, in the short term, this type of outsourcing provides Aladdin with flexibility – costs are minimised as Aladdin only pays for work completed rather than ongoing salary bases.
- **Control over Chinese JV:** Aladdin does not own the Hong Kong entity that is the joint venture partner of Beijing Guo Yi Hui Hospital Management in China. The company is reliant on the Hong Kong entity paying licence fees and does not have any control over the operations of the JV.
- **Competitive landscape:** The market is very active for healthcare software applications and Aladdin will be competing against companies with much higher levels of funding.
- **Currency:** Aladdin will initially earn revenues in RMB, HKD and USD, but reports in Euros. Any fluctuations could have a material impact on the financial statements. As the company internationalises, we would expect currency risk to be less concentrated towards these pairings.

Financials

As the company listed on the Düsseldorf Exchange via a reverse takeover, there are limited financials available to review. The table below shows the financial history available – the company did not trade in a material way in the last two months of 2017 after the reverse takeover. The main transaction in the year was the fund-raising in November, which provided the company with a cash position of €6.4m at the end of FY17.

Exhibit 6: Financials		
(€000s)	FY16	FY17
Income statement		
Expenses	95.7	25.9
Tax	0	0
Net loss	95.7	25.9
Balance sheet		
Assets		
Receivables and other assets	0.9	0.9
Cash	202.5	6,392.2
Other assets	0	3.6
Total assets	203.4	6,396.7
Liabilities		
Trade payables	0	1.9
Accruals	7.8	14.5
Payables owing to shareholders	0	0.6
Total liabilities	7.8	17.0
Share capital	300	6510
Retained earnings	(104.4)	(130.3)
Total equity	195.6	6,379.7
Equity and liabilities	203.4	6,396.7

Source: Aladdin Blockchain Technologies

Due to the early-stage nature of the business, we are not in a position to provide forecasts for the business. We discuss below our understanding of the company's intended business model.

Business model

The company intends to generate revenues from the following:

- **App subscriptions:** After providing free use of the app for 12 months, the JV will charge a monthly subscription fee for the use of the app, currently estimated at c \$1/month. Aladdin will be entitled to 7.5% of the monthly subscription fee. It is expected that hospitals will bear the costs of doctors and patients using the app. The JV has agreed to pay Aladdin minimum revenues of \$1m in FY18, even though app users will still be within the 12-month free use period.
- **Marketplace commissions:** The JV will earn commission on any products/services sold in the marketplace. This would include sales of health/life insurance, drugs and wellness products. Aladdin will be entitled to 20% of the commission fees.
- **Sale of data:** Aladdin expects to be able to sell bulk uploads of data to insurance companies, pharmaceutical companies and any other companies interested in medical and lifestyle data. The company also expects to be able to provide analytics-as-a-service to generate actionable insights from analysing the data itself, which it would aim to sell to governments and commercial organisations.
- **Subscription for Zurvan blockchain-as-a-service tool:** Aladdin plans to charge members a fee to join its blockchain ecosystem. This is likely to be in the form of a blockchain-as-a-service subscription, which would provide members with the tools to become a node and participate in the blockchain.
- **Transaction fees on the blockchain:** Aladdin has not yet finalised how it will monetise its blockchain applications. One method it is considering is to charge a small percentage of any transactions that take place on the blockchain.

Cost base

The current cost base includes the following types of expenses:

- **Development costs:** Aladdin has outsourced software development to Elemental Concept, the software development company founded by Bimal Shah. Aladdin is paying Elemental on a monthly basis depending on the work performed in the prior month.
- **Platform support:** The company has outsourced the build and maintenance of its big data platform to Cazena, a specialist in cloud-based big data platforms. The platform is based on a Cloudera data storage system. This is paid for on a monthly basis.
- **Premise-related costs:** Rent, IT hardware and software, utilities.
- **Admin costs:** Including listing-related costs and management costs.

We would expect that as the company grows, it will hire staff to cover sales and marketing and operations in the countries it is targeting, and will also hire in-house developers to build and maintain its technology.

Contact details	Revenue by geography
Aladdin Blockchain Technologies Holding SE Unter den Linden 10 10117 Berlin Germany www.aladdinid.com	N/A

Management team	
Chairman: Wade Menpes Smith Wade has 16 years of emerging markets and entrepreneur direct private investment experience in Russia and China. He has built, invested and sold multiple technology and internet businesses in both of these markets.	Deputy chairman: Bimal Shah Bimal has extensive experience from start-ups to multinationals, enabling digital solutions, business transformation and bringing existing companies into the digital world by creating new solutions with technology.
Director: Alexander Badenoch Alexander founded independent recruitment companies Badenoch & Clark (1979-2000) and Venn Group (2000-), both of which have turnover in excess of £120m. Alexander qualified as a Chartered Accountant with Ernst & Young.	

Principal shareholders	(%)
Wade Menpes-Smith	37.4
Badenoch family	36.9

Companies named in this report

Ping An Healthcare and Technology (1833 HK), Alibaba Health Information Technology (241 HK), Tencent (700 HK), Baidu (BIDU US).

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