

TERN PLC

SOFTWARE AND COMPUTER SERVICES

27 September 2019

TERN.L

9.5p

Market Cap: £24.2m

SHARE PRICE (p)



12m high/low

20.3p/7.1p

Source: LSE Data

KEY DATA

Net (Debt)/Cash	£1.9m
Enterprise value	£22.3m
Index/market	AIM
Next news	Interim results
Shares in Issue (m)	254.3
Chairman	Ian Ritchie
Chief Executive	Albert E Sisto
Finance Director	Sarah Payne

COMPANY DESCRIPTION

Tern predominantly invests in software companies, with proven technology, based in the UK but with global ambition.

www.ternplc.com

TERN PLC IS A RESEARCH CLIENT OF PROGRESSIVE

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Smart money

Tern offers UK investors an interesting and “different” proposition. Acting as an AIM-listed investor in private-equity style deals, the business provides its shareholders with a diversified way to gain exposure to a broad range of IoT-related assets. The group benefits from a very well-connected North American presence, an effective UK platform to locate and execute transactions, and a number of exciting investments already in place. H1 results published this week demonstrated a modest ongoing improvement in NAV, and the group continuing to deliver on its strategic plans.

- Background** Tern has investments in six high-growth portfolio companies, with stakes in the more material assets ranging from 35% to 100%. Invested capital at June 2019 stood at some £15.8m, with NAV having increased during the first half to £17.5m compared to £16.8m at the end of 2018.
- Strategy** The group’s strategy is clear : invest in UK and European businesses active in the Internet of Things arena, provide additional benefits to these investees (network relationships, mentoring, synergies between portfolio companies etc) and in particular to utilise a strong US West Coast presence to deliver value, either through M&A, partnerships or in other ways.
- Portfolio** The current portfolio is dominated (in financial terms, at least) by Device Authority, a provider of security software platforms to assist large organisations in the scale-up of IoT deployment. Other investee companies include businesses exposed to medical and industrial IoT opportunities. We detail the investee companies within the body of this note.
- Evidence to date** The group has only relatively recently begun to drive the current strategy, so it is perhaps too early to look for concrete outcomes or tangible crystallisation of valuation uplifts. Tern does not alter the reported NAV of one of its holdings without an external third party valuation such as new funding round. The group has, however, seen no “down rounds” in follow-on investment activity.

Tern’s investment capital is “smart” – the North American angle should both help companies during their time in the portfolio, and potentially allow US VC valuations when the time is right to achieve an exit. Positive momentum in strategic delivery continued in H1 2019. We look forward to hearing further news on portfolio composition, as well as hopefully strong organic performance from the group.

INVESTEE COMPANIES



DEVICE
AUTHORITY

FUNDAMENTALVR



Wyld Networks



Executive Summary / Investment Thesis

The Internet of Things

The Internet of Things (“IoT”) relates to the vast number of devices being developed and installed which use the internet to transfer information in a setting which often has no need for human interaction or input. Connected devices range from cars and aeroplanes at one end, through elevators, industrial machinery of all types and down to tiny medical implants or minute tracking devices.

Around this burgeoning number of connected devices is growing an array of companies, all aiming to benefit in some way from the opportunity. There is a clear need for scalable and secure management of the devices themselves, for management of the vast amounts of data generated, and for workflow- and rules-based integration of these assets into the working practices of companies, large and small. Equally, whole new industries have been rendered “possible” through these advances in technology – companies are being established to allow measurement and monitoring of activities never previously captured in this way, and novel services and business models are emerging.

Industrial and Medical markets

Within this landscape, the Industrial and Medical sectors are both exciting areas, known somewhat confusingly as IIoT (“Industrial Internet of Things”) and IoMT (“Internet of Medical Things”). We describe these areas in more detail below, but they both share the need for absolute and rock-solid data security and privacy, juxtaposed with the requirement for open access to the machines/devices from multiple applications and locations.

HIPAA in the North American medical market, and GDPR (and other legislation) in the UK and Europe are both drivers of caution and focus on delivering IoT platforms that can be guaranteed resilient to attack. This combination of security and openness creates challenges for those seeking to implement robust systems, but also offers opportunities for businesses that can offer solutions to the various problems.

Tern’s offering to investors and portfolio companies

Tern offers a UK-based platform, investing in UK and European businesses in IoT or closely-related areas, which the group takes to include any application (program) or device that collects or manages information via the Cloud. The group also exposes investee companies to :

- North American contacts and relationships
- Other companies within the Tern network
- Potential for follow-on investment at US-style valuation multiples
- Avenues to eventual exit to North American buyers

Tern also benefits from a material exposure to the North American tech landscape, via CEO Al Sisto’s network of relationships and contacts. Al’s career includes a number of years as COO of RSA Security (sold to EMC for \$2.1billion in 2006). This role, along with his previous experience in other US tech businesses, has given Al an unparalleled set of connections across the cyber-security and enterprise technology marketplace.

A recent Capital Markets Day hosted by the group included contributions from the investees; each was able to give specific examples of the ways in which they have benefited from this US presence – one company (Device Authority) credits Tern with helping find and hire a new CTO.

Clearly, these benefits are also relevant to investors in Tern itself – shareholders should benefit from valuation uplifts as deals are done, as the portfolio groups deliver organic growth, and from the long-term upside around IoT evolution.

Current portfolio

The group currently owns six investments – the main four are described in detail below, with Tern owning material stakes in each :

- **Device Authority** (£12.3m of NAV as at 30 June 2019) – automates the provision of secure platforms for IIoT and IoMT devices and associated applications. Medical is the largest current sector in terms of client activity, but the process is applicable very broadly, can managed complex PKI (Public Key Infrastructure) or other environments, and offers long-term recurring revenues
- **FundamentalVR** (£2.2m of NAV) – provides a software simulation environment, allowing surgeons' accuracy to be measured objectively for the first time
- **InVMA** (£1m of NAV) – is focussed on heavy-industrial clients, with a platform to help implement IoT sensors and monitors; InVMA also provides associated services
- **Wyld Networks** (£78,000 of NAV) – has a wireless mesh technology to allow low-power networks to be formed, often in a smart-meter environment

Tern also has very modest equity stakes (<1%) in two other companies – Seal Software and Push Technology.

N.B. Tern does not alter the reported NAV of one of its holdings without an external third party valuation such as new funding round.

Recent developments

Tern has reported H1 2019 results which reflect the continued development of the Group and its investments. It ended the interim period with net assets of £17.5m and reported a loss for the period of £0.6m (H1 2018: loss of £0.3m) with no exchange rate revaluations necessary in the period just reported. The net asset value per share at 6.9p for the period was an increase on the 6.2p calculated as at 30 June 2018 and a slight decrease on the net asset value per share of 7.1p at 31 December 2018.

Summary and conclusion

Tern provides UK investors with an unusual opportunity – private equity style investment exposure in relatively early-stage businesses with a focus on IoT. Clearly each investment is high risk, but over time the portfolio will expand and diversify, and we would hope that ongoing growth in the IoT industry should both help valuations and allow strong organic performance within the portfolio of assets.

Coming months could offer a combination of further investments (the group currently sits with some £1.4m of net cash), contract and client news from the investees, and potentially even activity in terms of developing the portfolio strategically. We await developments with interest.

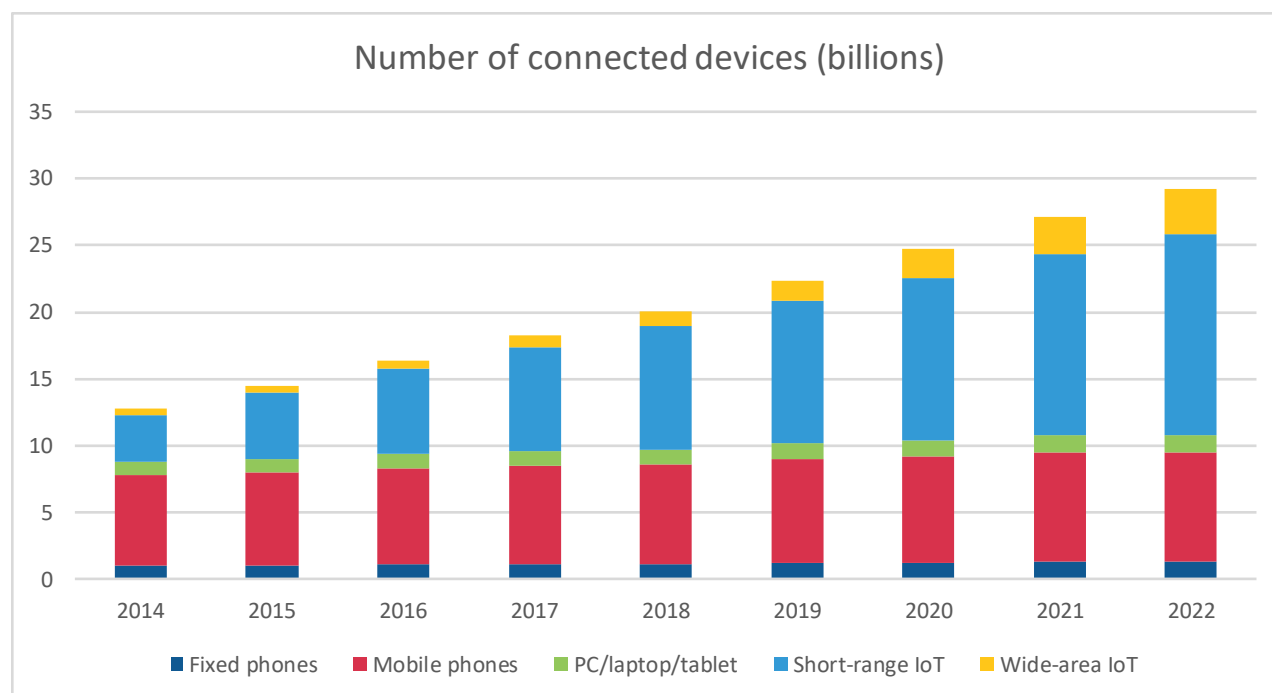
Introduction to IoT

Market scale

The IoT marketplace covers a very broad array of connected devices – anything that connects to the internet (or cloud) and sends/receives data. The number and complexity of such devices has been growing for many years, largely driven by a number of fairly-obvious factors :

- Reducing costs of hardware and connectivity (fixed / mobile)
- Improved performance (lower power consumption, better battery life)
- Enhanced functionality (platforms for managing data, and “actionable” insights)
- The chart below depicts the number of devices connected to the internet, and clearly demonstrates the material growth currently under way, and expected to continue, in the number of IoT hardware modules “in the field” over coming years.

SCALE OF CONNECTED DEVICE LANDSCAPE



Source: Ericsson

“What goes inside” a typical IoT connected device...?

Outside of the mainstream markets for phones and PCs/tablets, the “standalone” IoT devices generally consist of a power supply (battery or wired), some core electronics or control hardware (often linked to, or including, a sensor or monitoring device of some kind) and a connectivity module to provide the link to & from the internet (and the cloud).

Prices of these devices, and their sizes and power consumptions, have been steadily falling for many years – the IoT market also benefits from design improvements and cost reductions in the mainstream mobile phone segment.

Uses cases almost beyond number...

The main driver of uptake across all IoT devices, however, has been the massive proliferation in use cases and ways of putting IoT connectivity to practice, and achieving benefit for a customer or user. The range of uses to which connected electronics can be put is limited only by human imagination and ingenuity...and every week, additional new systems and platforms are launched. We will describe the “mainstream” use cases for IIoT and IoMT in the section overleaf, but the image below draws together three less-obvious manifestations of IoT:

EXAMPLE USE CASES



Source: Company information

- Costa Coffee uses IoT to connect “unattended” coffee machines – they self-report when running low on consumables, and also alert maintenance teams when errors are detected
- Farmers across the world are benefitting from IoT connectivity in their tractors – ploughing in straight lines saves wastage, and crop planting can be optimised by electronically mapping the field for maximum yield
- Even medicine bottles are getting the “IoT treatment”...the model shown contains an accelerometer (to measure movement) and connects to the link unit plugged into the socket...if a patient fails to open the lid within a certain timeframe each day, relatives or healthcare staff are alerted. In the following section, we focus more closely on the Industrial and Medical IoT markets, where Tern has chosen to concentrate its efforts and investments.

Focus on Industrial and Medical IoT

Why Industrial and Medical?

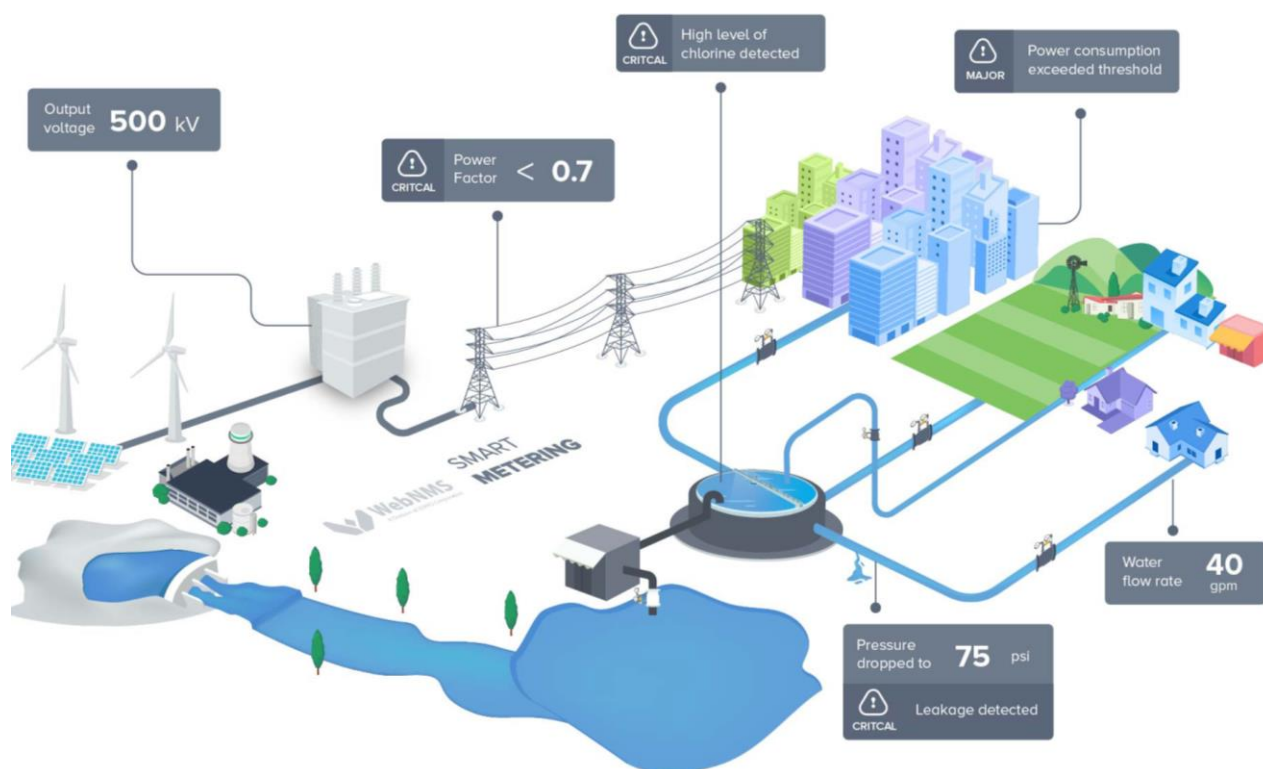
Tern has chosen to focus on two specific (albeit very large) areas of IoT development – industrial and medical. These segments have been chosen because, along with many other areas, there is an absolute requirement for data security and confidentiality, but the Industrial and Medical sectors have already evolved relatively mature and “agreed upon” use cases and methodologies.

Tern’s investee companies are therefore not attempting in all cases to “trailblaze” or “learn” new applications and technologies – they are working with industrial and medical device leaders, to implement and roll out IoT platforms in real-life proven settings to achieve clear and defined benefits for customers and consumers.

This “more mature” section of the market benefits from more rapid deployment of technologies at scale – essential in a world where individual device or application values may be low (measured in single-digit or low double-digit dollars in some cases) but the real value is driven through large numbers and significant rollouts across multiple locations and in multiple countries.

Further to the use cases mentioned above, it is worth noting the wide spread of uses within IIoT and IoMT. The image below depicts an industrial/utility setting, with a variety of different sensors monitoring different aspects of an infrastructure. Warnings and alerts allow the utility company to react to events, provide a more reliable and safer service, and the IoT devices contribute to a better understanding of the operation of the asset base.

Industrial IoT use case



Source: WebNMS Smart metering

Industrial IoT (IIoT)

IIoT broadly refers to the networked interconnection of data-generating devices such as sensors, measuring instruments and other devices which monitor and provide information about the performance of physical assets, processes or operations. These sensors often provide data on temperature, speed (of pumps turning or motors rotating), vibration levels, pressure, and the absence or presence of certain particles or substances – generally related to leak detection. Networked communication through, for instance, cloud computing, mobile technology and machine-to-machine allows for data collection, exchange and analysis. The robustness of connectivity and data collection in tandem with advanced analytics enhance the opportunity for improvements in productivity, safety and efficiency through the optimisation of processes and operational methodologies within an industrial site – a manufacturing facility, a processing plant or some other kind of large installation.

IIoT tends to be associated with manufacturing businesses whether they manufacture individual items or run a process-driven business. IIoT is often an integral part of digital transformation programmes for most manufacturers. They all have a number of goals in wanting to monitor the health and performance of their products as they are being used by their customers. The result should be information analysis that will inform action which, when taken, will add value to a business in some form by reducing cycle times, increasing throughput or increasing capacity utilisation. Given that the data to be analysed is almost always real-time, streamed, time-series data, it will often require processing so that it can be produced in a form which will match particular monitoring KPIs and from which the user can produce accurate analysis.

As well as monitoring on their own factory floors, this could be, for instance, in order to provide replacement parts in a timely manner or to minimise downtime of their customers' businesses. To achieve this, IIoT enables businesses to collect data from machines on the plant floor, assets in the supply chain or in use by their customers.

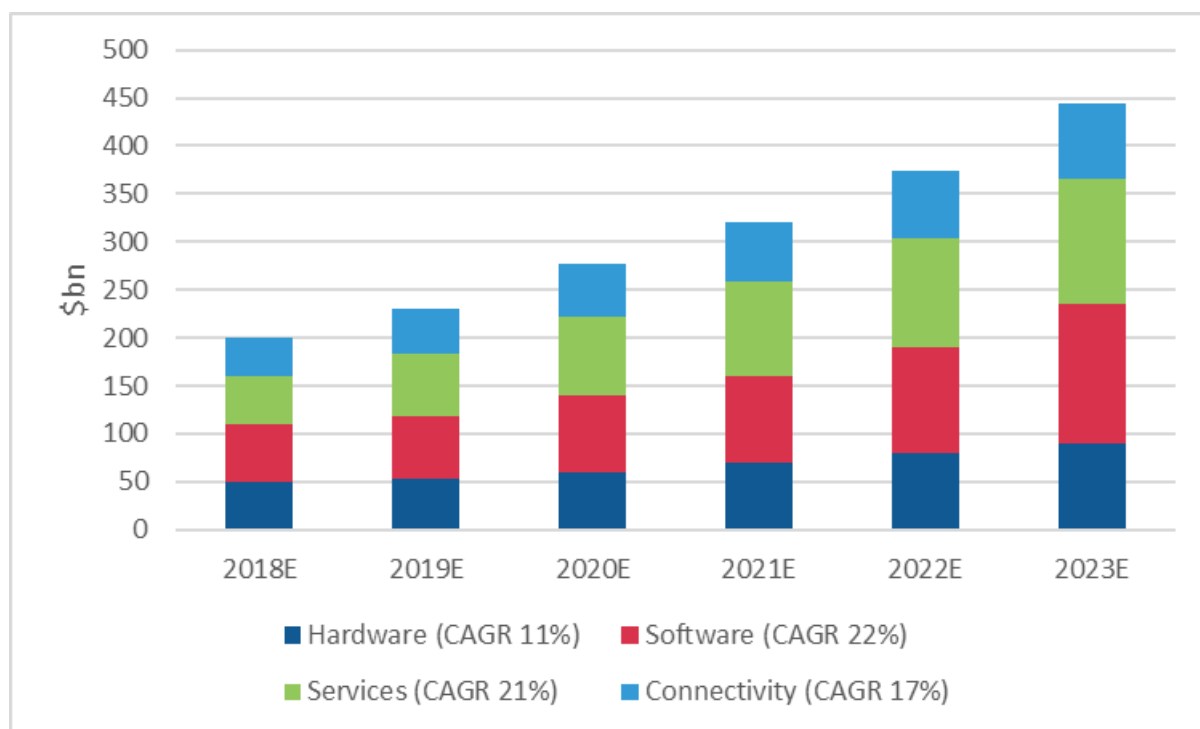
In addition, such analysis can be used to pinpoint flaws in manufacturing processes, thereby improving product quality, perhaps by reducing manufacturing defects or identifying particular design features that are causing issues with the manufacturing process.

Looking at regular and consistent data can also enable a manufacturer to better understand the demands of its customers and determine whether its assumptions around the usage of its products are, in fact, correct. Similarly, the process can help improve the customers' experience by optimising the usage of the products if they are not utilising certain features to the fullest extent.

Suppliers can also develop new revenue streams, perhaps in the form of support services or a Product-as-a-Service business model where customers purchase a 'result' rather than the equipment that delivers that result. For example, rather than purchasing a piece of equipment, a customer might purchase a certain number of operations that the equipment would otherwise undertake for the customer on its own premises. Essentially, the customer pays for the work, not the equipment. Potentially, this could remove the risk of performance from the customer to the manufacturer – who, arguably, should know the equipment better than the customer.

As shown in the Business Intelligence and IDC-sourced data below, there is an expectation that revenue will continue to grow in absolute terms – and, importantly, that the proportion of revenue driven by software and services will increase dramatically over the coming years.

IoT spending within Manufacturing sector –and a shift from hardware to software & services (\$bn)



Source: BI Intelligence 2018, IDC 2017

Internet of Medical Things (IoMT)

The IoMT industry can help monitor patients and equipment, informing and notifying care-givers and provide healthcare providers with real-time data to identify issues before they become critical or to allow for earlier intervention.

The segment can crucially also aid education and training of staff at all levels within the industry. In a time of budgetary squeezes, this has become particularly pertinent where such solutions can reduce time and costs.

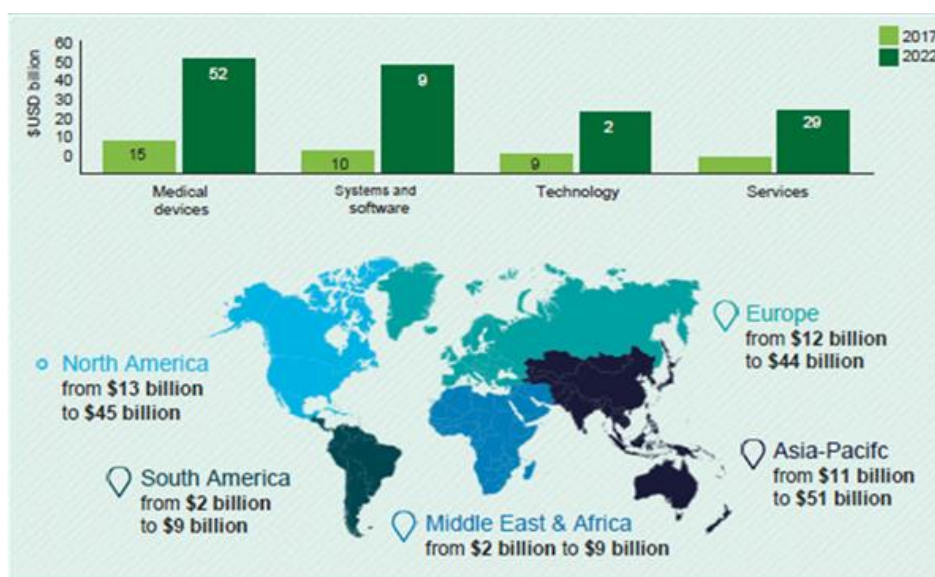
There are already a significant number of users of IoMT within the Healthcare sector around the world and it is, as we note below, growing quickly from an estimated value of over \$40 billion in 2017. Crucially, it is already making a difference to how the sector operates. The medical devices segment alone is expected to be worth over \$50 billion by 2022.

In July 2018, Deloitte published a report entitled Medtech and the Internet of Medical Things which looked at how medical devices are transforming health care. Patient interactions with equipment and devices are growing as technology evolves and the medical technology industry designs and manufactures an ever-wider range of products to diagnose, monitor, and treat patients. Objectives include helping health care organisations achieve better patient outcomes, lower healthcare costs, improved efficiency and new ways of engaging with and empowering patients.

The devices and the data they create and collect form the Internet of Medical Things (IoMT) – a connected infrastructure of medical devices, software applications and health systems and services. Connectivity between sensors and devices allows healthcare organisations to streamline their clinical operations and workflow management and to improve patient care, even from remote locations. New strategies are being evolved to harness data provided and make the resulting analysis relevant to users and providers of healthcare to promote better health outcomes at more reasonable costs.

Given these positive benefits, and the potential value they create, it is unsurprising that Deloitte and others expect the industry to grow rapidly over coming years:

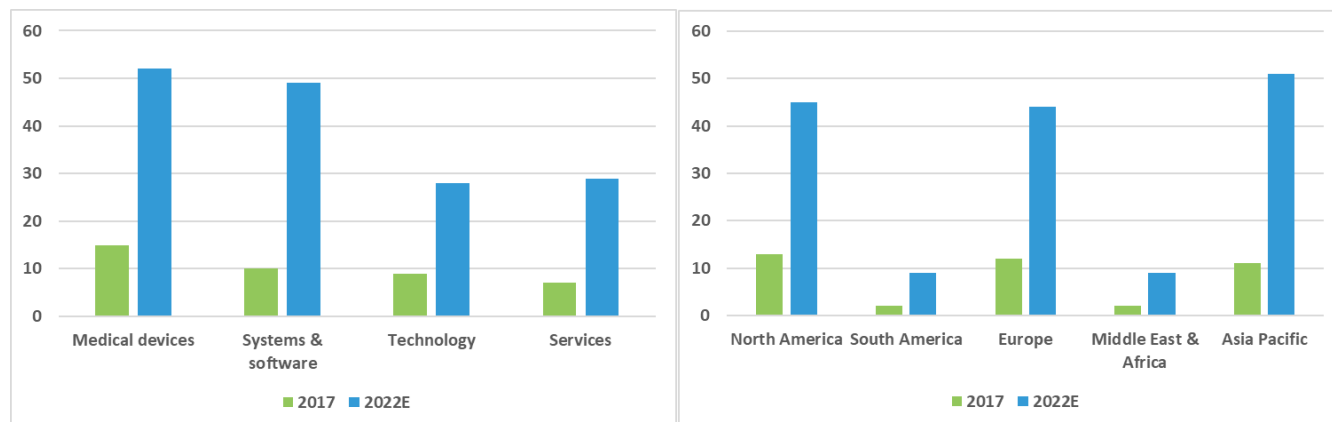
Internet of Medical Things – growth rates between 2017 and 2022E



Source: Deloitte Medtech and the Internet of Things

The Deloitte report highlights that MarketsandMarkets valued the IoMT market at \$41.2 billion in 2017 and expects it to rise to \$158.1 billion in 2022. The connected medical devices segment (helping to diagnose, monitor and treat patients) of the IoMT is expected to rise from \$14.9 billion in 2017 to \$52.2 billion by 2022.

The estimated value of the Internet of Medical Things by segment and region (US\$bn)



Source: MarketsandMarkets

On a broader scale, a report by Grand View Research in March 2019 estimated that the global IoT in healthcare market size was projected to reach U\$534bn by 2025, expanding at a CAGR of nearly 20% over the period. The report also noted that the growing preference for real-time data monitoring among the healthcare practitioners to manage chronic diseases was expected to fuel further demand for IoT networks in healthcare institutions, saying “combinations of remote monitoring, mobile platforms, and analytics have cut the rate of readmissions of patients suffering from congestive heart failure, diabetes, and blood pressure”. Additionally, real-time data transmission allows patients to manage chronic diseases and medication dosage.

In 2018, services held the largest revenue share reflecting the high demand for improved decision-making in real-time and uninterrupted data flow between devices and people. Hospitals and clinics held the largest revenue share in 2018 following investment in digital technology. North America is expected to be the largest market owing to growing adoption of healthcare IT solutions and availability of the necessary infrastructure in the region while Asia Pacific expected to witness the fastest CAGR given the growing investment by pharmaceuticals & medical devices companies and increasing adoption of advanced technologies.

The healthcare industry has numerous regulatory frameworks and requirements. Those associated with medical compliance and protection of personal data are some of the more obvious areas which are pertinent to anyone producing, collecting and analysing data. For instance, there is the Health Insurance Portability and Accountability Act (HIPAA) in the United States, GDPR legislation in the UK and Medical Devices regulation in the EU. In the UK, private providers that operate in the US need to adhere to HIPAA as well. The UK’s National Health Service has security policies for England, Wales and Scotland which are aimed at safeguarding patient data and ensuring organisations within the NHS adhere to the Data Protection Act (DPA). Both HIPAA and the DPA require that individuals handling patient data only have access to data that is necessary for them to perform their roles.

Tern and its proposition

Tern has a clear and well-articulated strategy...it aims to invest in exciting IoT-related businesses, with a focus on Industrial and Medical plays. The group's remit includes UK and European businesses, and Tern only invests where it can achieve a degree of "influence" – which Tern measures by looking at board representation, and involvement in strategic direction-setting, rather than necessarily a specific percentage of share capital.

Once Tern has chosen to make an investment, and the company becomes part of the portfolio, the group offers investees a range of benefits :

- North American contacts and relationships, especially relating to Al Sisto's broad network across a range of cyber-security and tech sector segments
- Potential for cross-selling or partnerships with other companies within the Tern network
- Aspiration for follow-on investment at levels more like US valuations
- Avenues to eventual exits to North American buyers

Developing value within the portfolio

The group has formalised its views on the three stages to growing value within the portfolio, with approximate timelines and indications of activity at each stage of the process:

Tern's approach to value development over time

Stage 1

Infrastructure

Review, Plan, Business Model, Product, Recruitment

12-18 months to review, prepare plan and implement infrastructre changes to make the business a commecial success within three years

Stage 2

Growth

Strategic Partners, Marketing, Awards, Exports

18-24 months to create awarneness, build commercialisation and a case for the company to be acquired by a trade buyer

Stage 3

Realise

Complete, Add Value, Target Buyers

Up to 2 years to continue building whilst sale of business process is sought and executed

Source: Company information

What the investee companies say...

At the group's recent Capital Markets Day, the main portfolio companies presented their business models and described progress they were making within their chosen target markets. A number of the businesses also described some of the benefits they were seeing as part of the Tern family.

We have reproduced (verbatim) a small number of the comments and quotes below:

*"Thanks to Tern, **Device Authority**...found [an investing family] and funding partner, recruited a Board member, achieved an elevated status and visibility in Silicon Valley, hired our CTO and strengthened partnerships with InVMA"*

*"**FundamentalVR** has secured high level endorsement from NHS England, gained access to new potential industry customers and found new potential routes to market"*

Investee summary: Device Authority

Device Authority

	
What it does Provides simple, innovative solutions to address the challenges of securing the Internet of Things. Headquartered in the UK and with a technical development centre based in Fremont, CA, Device Authority is one of the global leaders in the provision of IoT security with its KeyScaler platform.	How it delivers It introduces a 'new paradigm' of IoT Security Automation that accelerates and simplifies the deployment of strong IoT security. It simplifies the process of establishing robust, end-to-end security architecture within the IoT. Enables customers to deliver efficiencies at scale through security automation.
Recent history The Cryptosoft platform was originally developed in 2010 for the Enterprise security market. The dedicated IoT Security entity was launched in September 2014 when Cryptosoft technology was acquired with backing from Tern Plc. In April 2016 Cryptosoft acquired Device Authority Inc, and subsequently changed its name to Device Authority Ltd	Technology Device Authority's patented dynamic key technology provides: <ul style="list-style-type: none"> • strong, device-based trust anchor for automated, scalable IoT identity authentication • delivery of data centric encryption services for IoT data in transit and storage
Tern ownership 56.8% 'A' shares \$2.7m convertible loan notes	H1 2019 valuation of Tern stake £12.3m
Example platform and service partners 	
Darron Antill, CEO, Device Authority: "‘Tern’s role has been very supportive in executing our strategy. Since joining the company, I have worked with the Tern team to sharpen our go to market strategy, acquired a US company to extend our offering and global footprint and rebranded the business, as well as increase our IoT ecosystem partners and associated pipeline.’"	

Source: Company information

Device Authority is a software-only IoT security company, helping customers protect their IoT devices, the applications they connect to, and the data generated.

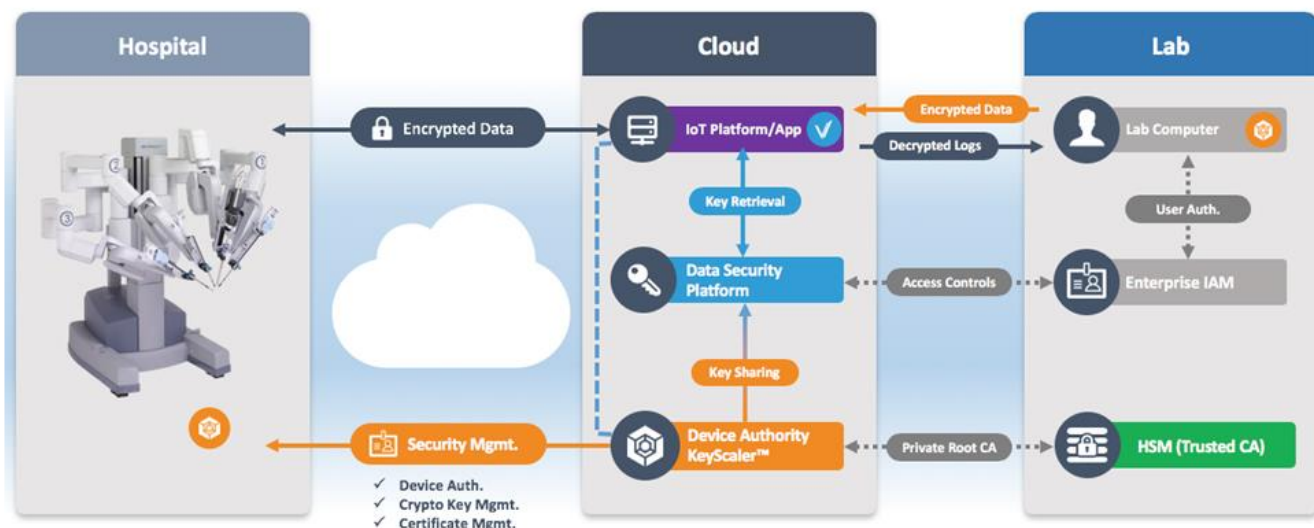
The majority of industrial and medical IoT implementations use PKI (Public Key Infrastructure) to secure the transmission of information. Device Authority helps customers automate and provision the management of PKI certificates, tokens and other methods of securing data.

The IoT Security platform, KeyScaler is built on a robust services-oriented architecture that can be implemented on premise or as a multi-tenant service platform for cloud and service providers. Device Authority has been using Amazon's AWS platform for the cloud delivery infrastructure, although it has recently also integrated with Microsoft Azure, partly in response to requests from customers already using the Microsoft architecture.

KeyScaler supports two flexible methods for device authentication: DDKG (Dynamic Key Generator) and PKI Signature+, a smaller installation good for retro-fit situations, or for devices constrained by available processor or memory capacity.

The diagram below demonstrates where their IoT security platform, KeyScaler, fits into an Internet of Medical Things (IoMT) scenario, helping a hospital manage and secure the connectivity of medical robots:

Device Authority's Keyscaler product within a Medical IoT setting



Source: Company information

The revenue model is a combination of base licence fees (a price of \$50k would be a reasonable base level) with an ongoing annual fee of perhaps \$5-\$15 per device. Note that this fee is for the software platform only – customers will pay separately for device connectivity and other aspects of their IoT deployments. For critical safety, data security and compliance applications, annual fees per device can reach \$1,000 or more.

Initial success has been seen in the medical and industrial sectors, with wins including a major global truck manufacturer and a large medical device group looking to connect up to 2,000 medical robots. Additional opportunities are being pursued in the automotive sector.

The expectation is that Device Authority's revenues will be very "sticky" with customers unlikely to churn away from the platform once installed, as the ongoing costs are relatively low, and migrating to other systems would be difficult to achieve and risky.

Summary: Device Authority helps industrial and medical sector customers build large-scale deployments of securely-managed IoT devices. The management of PKI keys or other tokens becomes a meaningful challenge at scale, and Device Authority's software suite (both on-device and in the Cloud) allows customers to codify and control the necessary processes.

Product detail: KeyScaler software platform

KeyScaler is a purpose-built device identity-centric Identity and Access Management (IAM) platform for IoT. It allows customers to securely register, provision and connect devices to IoT platforms, applications and services. The platform simplifies the process of establishing a robust, end-to-end security architecture within the IoT and deliver efficiencies at scale through security automation, without human intervention.

With the rapid scaling of the IoT, where new devices are continually being provisioned, this process rapidly becomes unmanageable without automation. The IoT demands an approach to identification that starts with individual devices – authenticated automatically and dynamically, with no manual intervention required.

KeyScaler has been specifically designed for rapid integration and interoperability – the technology is based on 11 issued patents and has received industry recognition from Gartner, Forrester, 451 Research, SC Magazine, Quadrant Knowledge Solutions

KeyScaler benefits as described to customers:

- Helps protect organizations from espionage, process disruption, sensitive IP and data theft through the delivery of end-to-end data security
- Reduces risk of cyber-attacks, such as the recent Mirai and BrickerBot incidents, executed by the exploitation of weak credentials. Through unique Automated Password Management technology account passwords are automatically set and managed on devices including automatically changing manufacturer's default passwords.
- Automates compliance through policies, minimizing costly manual intervention and manages risk for diverse industrial regulatory landscapes, including frameworks.
- Increased control and reduced total cost of ownership through the KeyScaler Internal Private PKI. Customers can generate their own internal private root certificate authority and key, to enable provisioning of self-signed certificates to devices.
- Leverages existing investment through availability of Managed PKI Connectors.
- Protects a customer organization's brand integrity and reputation through the prevention of certificate and key theft, cloning, impersonation and spoofing due to encrypted-state storage.
- Delivers significant cost savings and removes logistical challenges of large scale device deployments with bulk provisioning thereby removing the need for human intervention.
- Increases operational efficiency through automated user account password management. Manual overhead of password change management is removed and HR and IT security policies can be automatically implemented.

Background: encrypting data through PKI (Public Key Infrastructure)

PKI is a well-trusted framework of encryption and cybersecurity that protects communications between two computers. It uses two cryptographic keys: a public key and a private key. The public key is available to anyone. The private key is unique and remains secret. When communicating, one device uses the public key of the other to encrypt a message; the other (receiving) device uses its private key to decrypt the message on arrival. This allows the devices to transmit information through an insecure channel without risk of theft or tampering.

IoT platforms often use PKI to secure the transmission of information in this way, but there must be a reliable way to manage the keys and ensure that new device keys are provisioned correctly – and redundant devices' keys are decommissioned efficiently.

PKI requires a Certificate Authority (CA) to authenticate the digital identities of the various devices. A Registration Authority (RA) is authorised by the Certificate Authority to provide digital certificates to users on a case-by-case basis. All of the certificates that are managed by the Certificate Authority and the Registration Authority are stored in an encrypted certificate database.

Crucially, Device Authority allows the PKI management process (or management of other non-PKI security tokens/etc) to be entirely person-free and automated.

Investee summary: FundamentalVR

FundamentalVR

FUNDAMENTAL VR

What it does

FundamentalVR delivers VR haptic simulators for surgery creating a safe, measurable & repeatable space to refine skills. Its goal is to transform the way surgeons prepare, practice and refine their skills. The Company is led by surgical training experts and leading technologists who aim to place training simulation into the hands of medical professionals around the world, using low cost, readily available technology.

How it delivers

Fundamental VR. has built an immersive, surgical simulation application platform, Fundamental Surgery, to provide medical professionals with the opportunity to practice and test themselves within a safe, controllable space that is as close to real life as possible.

Recent history

In August 2019, Fundamental VR's educational platform, Fundamental Surgery, received Continuing Professional Development (CPD) accreditation for its entire current portfolio of surgical training simulations by the Royal College of Surgeons of England. Each simulation is now confirmed as an activity that demonstrates sufficient educational value to contribute to individual surgeons' CPD.

Technology

FundamentalVR's unique software platform, Fundamental Surgery, takes advantage of readily available VR software and devices, such as the FaceBook owned Oculus Rift, and combines these with cutting edge haptics to create a simulation system. It uses computer learning, while the software platform works together with haptic hardware devices to simulate the physical sensation of operating on human tissue.

Tern ownership

34.7% of Fundamental VR
£0.3m convertible loan notes

H1 2019 valuation of Tern stake

£2.2 million

Example clients and partners



Since Tern invested in May 2018, FundamentalVR has launched in the USA, Australia and New Zealand and appointed Hybrid Health as its channel partner for Australian and New Zealand markets. FundamentalVR has also launched a strategic collaboration and joint development agreement with the Mayo Clinic, resulting in the Fundamental surgery platform being installed in their US centres.



Source: Company information

Education, training and accreditation

Fundamental VR aims to give medical personnel access to the best simulations for surgery. The platform enables surgeons to rehearse, practice and test themselves within a controlled environment that is as close to real life surgery as possible, and can be achieved close to their place of work. The surgical simulations provided by Fundamental VR combine high fidelity experiences with high function touch experiences all delivered via a hardware/software combination. The company provides a suite of online simulations for use by hospitals and institutions which is called *Fundamental Surgery*. It also delivers customised simulations for medical device, pharmaceutical and healthcare companies with specific healthcare professional educational needs.

Fundamental Surgery combines VR experience with feedback in the form of the sense of touch to create a near-real operating experience. This means that the experience is measurable and repeatable in order to give consistent feedback on medical procedures.

FundamentalVR believes that this is in tune with the long term direction which the market is taking. Reflecting that sentiment, Tern's interim results announcement notes that a June 2019 report by MarketsandMarkets highlighted that the medical simulations market is expected to reach USD 5.16 billion by 2027 from an estimated USD 1.70 billion in 2019, at a CAGR of 14.9%.

The FundamentalVR platform delivers both education and accreditation for medical professionals – it can help train surgeons on new devices, and it can measure and assess their performance in standardised example simulated operations.

Fundamental VR's simulation product in use at St. George's Hospital



Source: Fundamental VR

In the medical marketplace, there are no reliable data points for surgical performance that are isolated from other influencing factors such as the actions of others, or reactions that are particular to an individual patient during an operation. The medical industry is facing a number of challenges which includes the cost and time to implement devices and drugs - both of which have been increasing. In addition, the complexity of procedures and training is necessarily becoming greater. This is compounded by a general lack of data around surgeon performance. For instance, a new consultant may initially undertake a series of relatively simple operations on “standard” patients, whereas a senior consultant professor predominantly deals with the most difficult cases. Consequently, the outcomes of the latter’s particular series of operations reflect the comparative degrees of difficulty.

That means that it is not reasonable to make direct comparisons between two surgeons with such different experience levels undertaking operations of varying complexity. Nevertheless, there is increasing demand from patients, from insurers and from care organisations for an objective way of assessing surgeon competence and skill.

This is where Fundamental VR's product comes into play. It is an even, universal measurement tool which is able to judge surgeons on the same inputs and outputs. The group's vision is essentially one of building a data source on training and compliance of surgical competency. The results may then be viewed by institutions, surgeons and potentially patients who can then make a reasonable comparison between surgeons using consistent data.

Fundamental VR’s go-to-market strategy focuses on three areas. Firstly, device manufacturers and pharmaceutical companies, secondly the hospital and medical education sector and, thirdly insurance – although the Company’s involvement with this latter sector is at a very early stage.

Device manufacturers and pharmaceutical companies

Fundamental VR’s strategy in this segment is to educate and accelerate the way in which products can be introduced to market. Its equipment is light and simulates surgical procedures to help with training. Users do not need to observe other operations and the software can be formatted in a bespoke manner for specific operations and equipment. It can be used in tandem with other coaching but essentially accelerates the process of training.

Fundamental VR charges an upfront fee for provision of a specifically-tailored platform with license fees per user thereafter.

Hospital and medical education

For this segment of the market fundamental VR provides a more generic version of the product which is used by the device manufacturers and which is for non-branded systems. Provision of this product is on a subscription model basis.

Insurance

As we note above, Fundamental VR's involvement in this segment is at an early stage. This market could take on a number of forms. For instance, it could provide expert insight into a surgeon's competence and be used in malpractice negotiations, risk mitigation or eventually to reduce premiums of surgical services providers - essentially helping to manage expenses.

Accreditation and competency

The company's product is aimed at helping to provide external validation of competence for surgeons. For fundamental VR both its main markets are essentially symbiotic. If it provides services into industry, it can use this as leverage to get into hospitals and education. The opposite also applies. Importantly, the product is accredited by the Royal College of Surgeons - a vital element to have – and which supports the product's usage in maintaining and recording the competence levels of surgeons. Surgeons need to accumulate 50 continuous personal development points (CPD) per annum. Each training session using Fundamental VR's product is worth 6 points and consequently surgeons can accumulate their CPD points while training and providing further data on their performance.

Equally important are the adoption of Fundamental VR's training products by the Mayo Clinic and also by the UCLA spine surgery unit. Other US institutions are working on adoption and the US market is the company's primary focus at present.

Investee summary: InVMA

InVMA



What it does

Founded in 2010, InVMA combines world-class management consulting expertise with objective technology advisory and implementation services to deliver innovative IoT solutions based on ThingWorx technologies. InVMA is an IoT systems integrator and a ThingWorx gold partner. It was the first ThingWorx European partner.

How it delivers

InVMA works with OEM clients and their users to address and leverage the disruption IoT creates for businesses. InVMA designs, develops and deploys applications and hardware that improve or transform the way organisations do business, creating new revenue streams, enhancing customer satisfaction and increasing operational efficiency. InVMA does this by combining its consulting expertise with hardware, software, IT and OT technical capabilities.

Recent history

During 2019, InVMA has announced a number of partnerships which include ones which enable the company to more easily connect assets and environments (with Robustel), to provide optimum savings to the Facilities Management industry (with iaconnects) and to offer customers a low risk, economical way to take advantage of the commercial opportunities of IoT or connected products and service (with ECA Services).

Technology

InVMA's main product, Assetminder, is based on the industry leading scalable IoT platform, PTC ThingWorx™. The platform's capabilities make it possible for users to correlate data, deriving powerful insights that can be incorporated into applications or displayed to the end user. Repeatable proven solutions include predictive maintenance blueprints to improve asset performance.

Tern ownership

50% of InVMA
£50k convertible loan notes

H1 2019 valuation of Tern stake

£1 million

Example clients



Since Tern's investment in late 2017, InVMA has launched AssetMinder and has focused on generating product sales. It also announced the integration of AssetMinder with Device Authority's KeyScaler; important proof point of Tern's influence in integrating the products and technologies of its portfolio companies. InVMA has already secured contract wins and strategic partnerships and in key segments of the Industrial IoT market.



Source: Company information

In Vendor Managed Assets (InVMA) focuses on original equipment manufacturers and the users who procure their products. For example, the products may be heavy industrial assets - for instance, compressors or turbines. The users of these OEM products could be end-market manufacturers or plant owners, or the machinery could be owned either by the OEM, or by a service provider "within" a third party's manufacturing setting.

Key product: Assetminder

InVMA has a strong level of in-house intellectual property. The business designs, develops and deploys applications and hardware that improve or transform the way organisations do business, by combining its consulting expertise with hardware, software, IT and IoT technical capabilities.

InVMA is a reseller of the ThingWorx platform (from PTC) which enables the building of an application quickly with inbuilt communications. InVMA addresses the variations in use cases through its solution (based on ThingWorx) called *Assetminder*. *Assetminder* is a gateway to and from the Cloud to connect to the client product. The group works with Cambridge-based ARM Holdings, through an ARM group company (Stream Technologies) to deliver management of the SIM-card based mobile connectivity platform.

The *Assetminder* product (which also integrates with Device Authority's *KeyScaler*) provides a flow of data from the device - essentially a series of data points, alarms and alerts. An end-user customer will pay an access fee for the platform and then pay a per-asset fee based on the type of asset, its value and the criticality of the asset to the business. For an OEM, pricing is based on the value of the asset.

The gateway used by the customer for monitoring the *Assetminder* product is usually 3G or 4G. However, it could also be Ethernet and Wi-Fi based. Sensors can be connected by Bluetooth or hardwired if necessary, and Ethernet is then used to connect to client monitoring systems.

Scaling up

Currently InVMA's focus is on realising the significant growth opportunity by scaling up the business. Users will pay more for each asset on the system so InVMA is aiming to upsell *Assetminder* to OEMs and, through the OEM channel, to end users. The plan is to increase the levels of license sales on the back of OEM end-market success. Pricing will be on a per asset basis with hosting costs billed as an additional item.

PTC have a license agreement with InVMA, allowing InVMA to sell *Assetminder* bundled with Thingworx - there is a potential risk that PTC could alter its licencing structure which could pressure the InVMA model, although we understand the group benefits from a multi-year deal with PTC, and could migrate to other (Microsoft or other) platforms if necessary. The additional IP which InVMA adds to ThingWorx is the crucial element that protects its market position.

Example customer requirements

Typically, OEMs may remotely manage a dumb product (either after-sale, or during a rental or managed service arrangement). Users of OEM products need to guarantee the uptime of their product or service. For example, the owner of a compressor may have a service agreement for a fast replacement in the event of failure, so it is valuable for all parties to implement monitoring of the device, so that maintenance can prevent failure, and in the event of a problem, replacements can be sourced as quickly as possible.

OEMs

When buying from InVMA, OEMs are very focussed on the quality of the hardware, so InVMA has been working over the last 12 months with ECA Services who are a major provider of IoT platforms (and associated Dell hardware). The company also works with providers of modems and chipsets who want to use InVMA to improve their sales through the marketing of *Assetminder*. InVMA also works with Sensorworks which provides vibration sensors - and it may work with consulting businesses such as DXC who would bring in InVMA to provide practical implementations as part of broader consulting projects. The company is currently investigating how to best approach selling *Assetminder* to mid-market OEMs.

Investee summary: Wyld Networks

Wyld Networks



What it does

Wyld Networks is focused on solving connectivity issues in the IoT sector and its product suite includes a LoRaWAN product. It has a majority holding in Wyld Technologies, mobile mesh networking solutions. These devices are finding a strong use case within the structural growth market for Smart Metering.

How it delivers

Wyld Technologies provide unique scalable device-to-device mesh networking. Mesh technologies are low-energy, low-cost solutions for transmitting and collecting information. Data is securely relayed to self-configuring local devices and can self-heal without a single point of failure. Wyld Mesh combines cloud-streaming, device-to-device mesh connectivity, and rich geolocation services.

Recent history

During 2018, Wyld Technologies focused on building out its development team and product platform, and now has a product roadmap that is in line with current market requirements with its ability to deliver and collect critical data with its ad-hoc mesh networking platform in the all critical "last mile".

Technology

Wyld Mesh is a heterogeneous real-time data network, combining all available connectivity and transport protocols. Using RESTful Web Services, a Streaming Data Websocket service, Push Notifications, and its patent-pending Smart Device Mesh solution, Wyld Mesh forms a resilient and efficient network.

Tern ownership

100% of Wyld Networks
90% of Wyld

H1 2019 valuation of Tern stake

£78,000
£0.5m short term loan

Example clients



flexiOPS completed its portfolio of EU funded research and development cloud projects during 2018 and has now re-focused on supporting the networking element of Tern's IoT enablement strategy by aiding the growth and development of the Wyld Technologies Limited ad-hoc mesh networking offering following their acquisition in late 2017.



Source: Company information

Management

Within a business such as Tern, the management team is arguably even more important than usual... the focus and strategy from the relatively small parent company must set the direction for the entire organisation. The group must continually assess a broad range of potential investments, while at the same time ensuring organic delivery from the (often only part-owned) portfolio and keep an eye on potential exits. We believe that the team below brings a strong combination of experience and focus.

Executive

Chief Executive – Al Sisto

Al brings to Tern over four decades of technology sector experience, including a number of years as COO of RSA Security, a major global player in the cyber-security market, which was sold to EMC for \$2.1bn in 2006. Al has been involved in a wide range of current and previous directorships and partnerships, including investing roles at Nauta Capital and Sixth Bridge LP, non-executive appointments at NokNok, Actual and a number of others. His career began with an Engineering degree from Stevens Institute of Technology, and executive roles at Hifn and Phoenix Technologies.

Finance Director – Sarah Payne

After qualifying with Ernst & Young, Sarah spent time within the firm's corporate finance department. She then moved to the BBC, where she had roles in commercial and investment strategy, and as Head of Financial Planning and Analysis. Sarah subsequently gained experience across a wide range of organisations as an outsourced Finance Director – all at Tech companies - prior to joining Tern.

Business Development Director – Bruce Leith

Bruce's career in technology began at IBM, and he has held roles at a number of other IT businesses, including (quoted group) London Bridge Software, Codestream and Dataworks. He is active on the Boards of a number of Tern's investee companies and is involved in sourcing and structuring new investments.

Non-Executive

Chairman – Ian Ritchie

Ian was the founder of OWL in 1984 (a precursor to the world wide web) and sold the business to Panasonic in 1989. He has been Chairman of Iomart, Krotos and Computer Applications Service, and has been involved in over 40 high-tech start-up businesses.

Non-Executive Director – Alan Howarth

Alan was a Partner at Ernst & Young, and became one of the founding partners of the EY Management Consulting business. He has been involved as Chairman and Non-Executive Director of a large number of public and private companies.

Financials

Tern's financial statements reflect the financial performance of the group (parent) company, and the portfolio companies' results are not consolidated, but rather the investments are measured and shown at "fair value".

We have chosen not to include financial forecasts within this note; the investee company performances would be extremely difficult to estimate, and the parent company has a very limited P&L, as described below. Nevertheless, we would make the following observations around the group operations (parent company costs) and the portfolio of investee companies.

Group operations

During H1 2019, Tern invoiced the investee companies some £52k for management services (this is common practice in private equity-style arrangements) compared to £64k in H1 2018.

The parent company had administrative costs of some £0.5m in H1 2019 compared to £0.4m in H1 2018 and £0.8m in FY 2018 and other (generally deal and loan-related) expenses of £0.2m. As at the end of H1 2019, Tern plc reported a cash balance of £1.4m following an equity issue of £1.5m in the period and £1.4m of investments in portfolio companies.

Investees

The investee companies' individual performances are not shown or consolidated within the group financial statements. We therefore know very little about the financial performance of these companies. We are told, however, that during 2018, revenue across the four main investments rose by some 58% y/y. Year-on-year turnover of principal portfolio companies from calendar year 2018 to 2019 is expected to be of the order of 50%.

The investments are, however, revalued to an estimate of fair value at each balance sheet date. The split of the group's net assets as at the end of 2018 are as shown in the pie chart below. "Other" refers to two very small investments made before the group's current strategy was adopted – Seal Software and Push Technology.

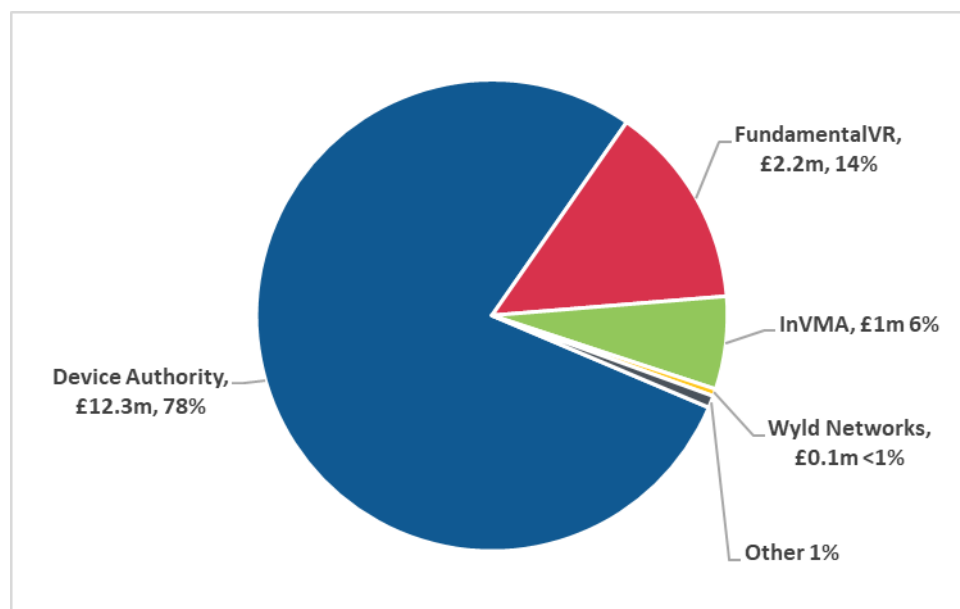
H1 2019 results

Tern has reported H1 2019 results which reflect the continued development of the Group and its investments. It ended the interim period with net assets of £17.5m and reported a loss for the period of £0.6m (H1 2018: loss of £0.3m) with no exchange rate revaluations necessary in the period just reported. Tern raised £1.5m during the period, strengthening the balance sheet and improving its investment options. It noted that it expected the year-on-year turnover of its principal portfolio companies from calendar year 2018 to 2019 would be of the order of 50%. In the six months to June 2019 the number of employees within principal portfolio companies increased by 9% over H1 2018 - a key growth measurement for those investee companies. Tern continues to focus on cost management. The increase in administrative costs in H1 2019 reflected additional advisor costs in the UK and the USA and an increase in directors' salaries.

In addition, there were one off legal and professional advisory fees relating to a potential transaction which Tern's Board notes "would have added a significant number of companies to the portfolio, increased our NAV and broadened our resources to support and manage the larger portfolio." It says that after careful due diligence, and with the support of its advisers, the Board decided not to pursue the opportunity any further.

The net asset value per share at 6.9p for the period was an increase on the 6.2p calculated as at 30 June 2018 and a slight decrease on the net asset value per share of 7.1p at 31 December 2018. During the six months to 30 June 2019, the fair value per share of the portfolio remained broadly stable at 6.2p (FY 2018: 6.3p; H1 2018: 5.1p) which included a 6% increase in the absolute portfolio value.

Net Asset Value split by investee company as at 30 June 2019



Source: Company information

Outlook

CEO, Al Sisto, confirmed that Tern remains committed to the medical and industrial areas of the IoT market through direct investments and innovative partnerships. Tern continues to aim for US Venture Capital Values for its UK investments in later series 'B' rounds and to create shareholder value and premium exit opportunities. It has set a target for its portfolio activities to achieve an average of 20% year-on-year growth in portfolio value by year end 2019 and beyond following 6% growth during the first half of 2019.

Risks and challenges

Tern plc risks and challenges

Risk	Impact	Management action/comments
Investment performance	Poor performance of investments could lead to drains on the group's cash position, and could render it more difficult to raise additional capital.	Tern takes an active role in the strategic direction of its investments and monitors all investments regularly. A Company director holds a non-executive Board position on all investment company boards where the Company has a significant (>10%) holding. Tern's management team has a strong track record of generating gains from early stage companies within the technology sector. The Company is building a portfolio of investments to mitigate the effect of poor performance of any single investment.
Key personnel	Tern is highly reliant on a small number of key personnel, including most notable Al Sisto, the CEO. Any changes in the senior team could have a significant effect on the group's ability to find, add value to, and exit from portfolio assets, and would render raising additional capital more difficult.	The Company offers a remuneration package designed to attract, motivate and retain key individuals. Key individuals in the investment companies are offered an attractive remuneration package and either shares or share option incentives.
Capital raising	The group requires capital to fund operating costs of the parent company, as well as to provide both initial and potentially follow-on investment capital for the portfolio. A change in the group's fortunes, or a deterioration in the UK capital markets might prevent the group raising the necessary additional capital.	The Company will maintain a sufficient cash balance to finance itself for a prudent period, or ensure that it has access to funds.
Increased competition	As the IoT space becomes more mainstream, it may attract the attention of additional investors and/or large corporate entities looking to invest. This could make it more difficult for Tern to source and execute new investments at acceptable prices.	Tern's management team has a strong track record of unlocking opportunities in the USA for UK companies which should remain attractive to potential investees.
End market downturn	The IoT market could slow its growth if, for any reason, large corporations began to take a more cautious view of IoT costs and benefits. This could be prompted by a failure to deliver on use cases, or security or other concerns.	The management team is constantly monitoring the development of the market and concentrates on investments with commercial solutions in markets within which it has considerable experience.
Litigation	The group invests in, and is involved with a relatively large number of companies for such a small business. There exists a risk that past, existing or potential investees or other companies could litigate against the group in relation to either concluded or aborted transactions.	Tern maintains a strong advisory base and takes legal advice on all investment and employment issues. It monitors its working capital to ensure it has sufficient funds to maintain operations during any economic slowdown.

Source: Progressive Equity Research

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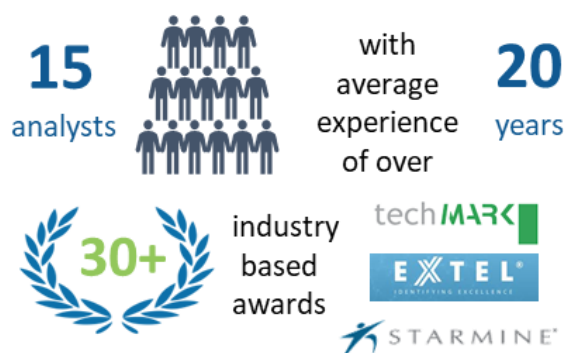
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