

Kleos Space S.A.

Australia / Germany

Initiation of coverage

 Bloomberg: KSS AU
 ISIN: AU0000015588

RATING	BUY
PRICE TARGET	AUD0.43
Return Potential	68.6%
Risk Rating	High

PIONEER IN SATELLITE-BASED RF MARITIME TRACKING

Kleos is a young “new space” technology company which will soon operate a constellation of nanosatellites in space capable of scanning the earth for radio frequency (RF) signals. The company’s nanosatellites will focus on signals from the maritime industry. Kleos’ innovative proprietary technology will enable precise geolocation and identification of ships, and can be used to identify activities such as illegal fishing, illegal immigration, piracy, sea smuggling and contraband. The company intends to commercialise the generated Data as a Service (DaaS) to governments, defence ministries and private customers. The rocket launch of the first system comprising four Nanosatellites is targeted for the end of Q2/19. Following a positioning and calibration process of 1-2 months, Kleos is poised to generate first revenues shortly thereafter. Six signed non-binding Memorandums of Understanding (MoUs), one of them potentially worth up to €3m, underscore the interest of potential clients. Kleos offers an interesting opportunity to invest in the highly attractive ‘new space’ field. We initiate coverage with a Buy rating and €0.27 (AUD0.43) price target.

Following the scouting satellite launch planned for approx. Jun/19, we anticipate strong revenue growth in the period 2019E-2022E accompanied by EBITDA and EBIT break-even in 2020E and 2021E, respectively. We expect that the successful satellite launch will attract the attention of many potential customers and accelerate the acquisition of new clients. We project sales of €1.1m in 2019E, growing at a CAGR of 174% to €21.6m in 2022E.

Attractively valued We value the company using a DCF model, which yields a price target of €0.27 (AUD0.43) per share. We believe that the satellite launch and a strong financial improvement in 2019E and 2020E will have a positive impact on the share price over the coming quarters. With valuation at attractive levels we initiate coverage with a Buy recommendation.

FINANCIAL HISTORY & PROJECTIONS

	2017	2018	2019E	2020E	2021E	2022E
Revenue (€m)	0.00	0.00	1.05	6.40	12.50	21.60
Y-o-y growth	n.a.	n.a.	n.a.	509.5%	95.3%	72.8%
EBIT (€m)	-0.18	-2.19	-1.92	-0.87	1.06	5.64
EBIT margin	n.a.	n.a.	n.a.	n.a.	8.4%	26.0%
Net income (€m)	-0.18	-2.20	-1.92	-0.86	0.79	4.17
EPS (diluted) (€)	-0.01	-0.03	-0.02	0.00	0.00	0.02
DPS (€)	0.00	0.00	0.00	0.00	0.00	0.00
FCF (€m)	0.26	-4.11	-5.25	-5.64	-2.92	1.42
Net gearing	267.0%	-74.0%	-45.4%	-26.0%	-3.3%	-10.4%
Liquid assets (€m)	0.46	4.26	4.01	3.37	0.45	1.87

RISKS

Risks include, but are not limited to technological risk, execution risk, shareholder dilution, and competition risks

COMPANY PROFILE

Kleos is a “new space” technology specialist aiming to launch and operate nanosatellites in space with the goal to scan the earth for radio frequency (RF) signals for geolocation purposes. The company is a pioneer in applying RF technology from space. The main focus will be generating data for the maritime industry. The company is based in Luxembourg and intends to sell the RF data as a service worldwide to government agencies, intelligence and maritime companies.

MARKET DATA

	As of 5/1/2019
Closing Price	AUD 0.26
Shares outstanding	106.60m
Market Capitalisation	AUD 27.18m
52-week Range	AUD 0.09 / 0.30
Avg. Volume (12 Months)	485,328

Multiples	2018	2019E	2020E
P/E	n.a.	n.a.	n.a.
EV/Sales	n.a.	14.6	2.4
EV/EBIT	n.a.	n.a.	n.a.
Div. Yield	0.0%	0.0%	0.0%

STOCK OVERVIEW



COMPANY DATA

	As of 31 Dec 2018
Liquid Assets	€ 4.26m
Current Assets	€ 5.33m
Intangible Assets	€ 0.00m
Total Assets	€ 7.25m
Current Liabilities	€ 1.48m
Shareholders' Equity	€ 5.76m

SHAREHOLDERS

Magna Parva Ltd.	23.4%
LTL Capital Pty Ltd.	13.9%
Tyler Corporation Pty Ltd.	3.3%
Bradley Saxby	3.3%
Free Float	56.0%



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INVESTMENT CASE

Kleos, a pure-play “new space” technology company operating nanosatellites capable of scanning the earth for radio frequency (RF) signals

We view Kleos as a young, innovative technology company capitalising on new applications emerging from the innovation-driven paradigm shift (e.g. miniaturisation of space craft and equipment) taking place in the space industry. The company is on the verge of launching and operating its own nanosatellite constellation consisting of clusters of four nanosatellites. These small high-tech satellites with a size of about 10cm x 20cm x 30cm will be positioned to fly in a predetermined formation at Low Earth Orbit (LEO) at approximately 500 kilometres height. The company is buying the nanosatellites and the rocket launch from the “new space” specialists GomSpace and RocketLab, respectively. This approach in our view guarantees cutting-edge satellites and maximises launch success chances. Based on Kleos’ novel technology mostly consisting of highly complex proprietary algorithms, the satellites are capable of detecting and geolocating RF signal emissions from earth with high precision.

First nanosatellites tracking application will attempt to improve security in the maritime industry

Kleos’ satellites will primarily focus on collecting RF signals from electronic devices used within the maritime industry, in order to generate valuable commercial intelligence data. Kleos will sell the generated Data as a Service (DaaS) worldwide. Maritime security applications include monitoring of illegal fishing, illegal immigration, sea smuggling (e.g. drugs smuggling) and environmental monitoring (e.g. illegal oil bunkering). The main advantage of the RF approach is that the instruments being tracked are essential for the ships’ navigating activities and cannot be waived, disconnected, spoofed or jammed, as is the case with technologies presently used (e.g. Automatic Identification System - AIS and Geo Positioning System - GPS). RF space technology is also complementary to existing satellite observation technologies such as Optical Imagery (OR) and Radar (SAR) to resolve maritime threats, leading to superior combined results.

Intelligence, Surveillance and Reconnaissance (ISR), Earth Observation (EO) or Maritime Security (MS) markets are growing at a CAGR of 5 to ca. 13%

Kleos’ current product portfolio is focused on highly innovative segments of the ISR, EO, or MS markets for government (i.e. defence) as well as commercial customers. With estimated markets CAGR of 5 to ca. 13% in the coming years, Kleos will benefit from the positive environment for commercialising its products. Increasingly complex threats and emergencies are driving the demand for ISR data. For example, illegal activities in the maritime industry represent worldwide losses for the governments and their economies in excess of USD63bn (source: Kleos, UN, IUMI, and IET).

Kleos is poised to be the first company to market RF data in Europe and Australia, and the second one in the US

Headquartered in Luxemburg, and with subsidiaries in the UK and Australia, Kleos is one of only two pioneering companies with space based RF capabilities active in the field. With the first scouting satellites launch planned for approx. June/19, Kleos is on track to be the first company offering its products to European and Australian customers. Kleos’ direct competitor, the US private company HawkEye³⁶⁰ launched its first scouting satellites in Dec/18 and started with RF tracking in Feb/19. However, HawkEye has a clear focus on the US market. HawkEye claims to have an order backlog in excess of USD100m, which suggests a large industry interest. None of the traditional old space players (e.g. Boeing, Airbus, Lockheed Martin, etc.) is offering RF intelligence data and several of them are showing interest in cooperating or buying the RF data from the newcomers to integrate it into their portfolio. They are attractive partners and customers which have strong business relationships with relevant defence institutions worldwide giving access to large orders.



We see strong sales growth and increasing margins in the period 2019E-2022E Kleos is very well positioned to gain market share and capture high margins from its RF product portfolio. The 6 MoUs signed so far give us confidence that the company is on track to generate first sales in 2019E (FBe: €1.1m), achieve a positive EBITDA of €0.8m in 2020E, and a positive EBIT of 1.1m in 2021E. Overall, we expect Kleos to deliver robust sales growth and margin improvement in the period 2019E-2022E, with sales increasing at a CAGR of 174% and EBIT-margin reaching 26% by 2022E.

Kleos' shares are in our view undervalued Our proprietary DCF-valuation model suggests a fair value for Kleos of €55.5m, which equates to €0.27 or AUD0.43 per share (using an FX rate 1 AUD = 0.63 Euros), based on a fully diluted number of shares of 205.4m. We initiate coverage with a Buy rating and a price target of €0.27 (AUD0.43). We anticipate that the strong positive share price momentum started in February 2019 will continue, as the stock will benefit from news of the imminent satellites launch leading to sound revenue growth as well as substantial EBIT improvements in the coming quarters.



SWOT ANALYSIS

STRENGTHS

- **Experienced Board of Directors** Air Commodore Peter Round (Chairman of the Board and Executive Director), Andrew Bowyer (CEO), and Miles Ashcroft (CTO) are highly qualified executives each with 15-30 years of experience in the aerospace and defence industry.
- **Innovative proprietary technology for novel satellite radio wave (RF) sensing with potential application in the maritime industry** The company's technology represents a breakthrough for space sensing applications in the maritime industry such as monitoring of illegal fishing, illegal immigration, sea smuggling and contraband (e.g. drugs smuggling) and environmental monitoring (e.g. illegal oil bunkering). These illegal activities represent worldwide losses for governments and economies in excess of USD63bn (source: Kleos, UN, IUMI, and IET).
- **First company to market RF data in Europe and Australia** Kleos will be the first company in Europe and the second company worldwide to launch a satellite constellation to scan for RF signals. With the launch planned for approx. June 2019, Kleos is about 6 months behind its US competitor HawkEye³⁶⁰, which has a focus on the US market. Headquartered in Luxembourg, and with subsidiaries in the UK and Australia, Kleos is poised to be the first company to offer its products to European and Australian customers.
- **State of the art nanosatellites, sensing equipment and rocket launching technology** Kleos uses nanosatellites (CubeSats), payload from GomSpace and Rocket Lab equipment for the launch into space. Both companies are technology leaders in their respective tasks. Furthermore, CubeSats are cheaper and have a shorter technical life of up to 5 years compared with traditional satellites (about 15 years), allowing the company to incorporate new technology faster by replacing satellites. This gives the company a competitive advantage.

WEAKNESSES

- **Young small cap with short track record** Founded in 2017, the company is still relatively young and small, and it still has to prove its ability to operate sustainably in the long term.
- **Small size compared with large old space players** With a market cap of approx. €16m, €8.4m of funds raised and no sales, Kleos is small compared with the large, established old space players such as Boeing, Airbus, Lockheed Martin, etc. generating sales in the multibillion USD range. Kleos thus lacks financial and marketing strength compared with the giants of the industry.
- **Modest cash position, ability to raise large amounts of money unproven** As of the end of Q1/19, Kleos had €2.8m in cash leaving it with little room for further expansion of its satellite fleet. We estimate that the company will require further funds of about €10m until break-even is achieved by 2021E.
- **Capital-intensive business model** While CubeSats are significantly cheaper than traditional satellites, the company's business model requires CAPEX in satellites, the corresponding payload and launch for expansion and replacement. For a small company of Kleos' size (balance sheet of €7m by FY/18), it may be challenging to raise sufficient funds to finance CAPEX.



OPPORTUNITIES

- **Target Intelligence, Surveillance and Reconnaissance (ISR), Earth Observation (EO) and Maritime Security (MS) markets are growing at a CAGR of 5 to ca. 13%** Kleos' current product portfolio is focused on highly innovative segments of the ISR, EO and MS markets. With estimated market CAGRs of 5 to ca. 13% in the coming years, Kleos will benefit from a positive environment for commercialising its products.
- **There appears to be strong interest from governments and industry in RF data** Prior to launching its satellites into space, Kleos has closed several Memorandums of Understanding (MoUs) with interested clients. Moreover, Kleos' only direct competitor, US-based HawkEye³⁶⁰, announced an order backlog in excess of USD100m, which demonstrates the high degree of interest in the data it generates.
- **Portfolio expansion through development of further applications in additional segments, such as aircraft tracking** Kleos' management sees potential to further grow the company's product offering by expanding into new areas. Our current sales forecast for Kleos is based on the maritime segment only. We therefore see upside to our projections coming from additional markets.
- **Capitalising on company's expertise in futuristic space fields in the mid-long term** The company has developed expertise and IP for building satellites in space, which is an emerging field in the "new space" market.

THREATS

- **Technological risk** The emerging commercial "new space" industry is based on disruptive technological jumps in performance. While rocket, satellite and sensing equipment are achieving unprecedentedly high levels of performance (e.g. satellite launch failures are down from over 60% in the 1960s to around 5% or less currently), these technologies are new and still have to generate a solid track record over the longer term.
- **Execution risk** Once the first satellite is in space by approx. June 2019, the company will have to translate current existing business relationships and MoUs into service contracts, acquire new clients and generate sales. First sales are set to commence in Q3 2019.
- **Competitive risks** The US company HawkEye³⁶⁰ is currently the only direct competitor to Kleos. HawkEye has several advantages. HawkEye was funded two years earlier focusing on the largest and highly lucrative US market. It has also raised about USD30m (vs. Kleos €8.4m plus €2.0m grants), has a larger staff of 31 (vs. Kleos 14), while its level of technological development and commercial activities have produced an order backlog of USD100m (Kleos up to €3m). Nevertheless, in our view the market is large enough for two players. Kleos still has the opportunity to catch up and it will also have a head start in Europe and Australia. We can also not rule out that further competitors will enter the market in the future, challenging Kleos' market share and its ability to establish itself.
- **Shareholder dilution** Kleos will need to conduct additional capital increases to ramp up its satellite cluster portfolio from 1 in Q2/19 to a target of at least 10 over the next years. We note that the costs of buying and launching additional satellites are currently approx. €2.9m per cluster of four nanosatellites.



VALUATION

Our valuation is based on a discounted cash flow model. We believe that a DCF valuation methodology is best suited to capture the value of Kleos' operations, as it captures the longer-term business prospects of the emerging "new space" industry. Taking into consideration typical life-cycle patterns in new technology industries, we have applied a two-stage growth model, which includes detailed projections of future sales, operating profit and free cash flows for the planning period 2018E-2030E. We have assumed a terminal free cash flow growth rate of 2.0%.

Using First Berlin methodology, which accounts for company-specific risk factors, we derive a cost of equity (COE) of 16.0% for Kleos. Our calculation is based on a risk-free rate of 0.5%, a market risk premium of 5.0% and a company specific risk coefficient of 3.1. Based on our forecast of uninterrupted positive free cash flows starting in 2022, we believe that Kleos will continue to operate with a negligible level of debt in the long run leading to a 100% long-term share of equity. We thus calculate a WACC of 16.0%, which we use to discount the projected cash flows. Including our estimated net cash of €12.5m, we value Kleos at €55.5m. Based on a fully diluted number shares of 205.5m we calculate a fair value per share of €0.27 or AUD0.43, using an FX rate 1 AUD = 0.63 Euros.

Using our ten-factor risk analysis, we derive a High risk rating for Kleos. The main risk factors we identify are technological risk, execution risk, shareholder dilution, and competition risks.

Figure 1: DCF Model

All figures in EUR '000	2019E	2020E	2021E	2022E	2023E	2024E	2025E	2026E
Net sales	1,050	6,400	12,500	21,600	33,600	43,400	49,500	55,500
NOPLAT	-1,923	-869	784	4,170	9,190	12,805	13,949	15,505
+ depreciation & amortisation	421	1,631	2,900	4,350	5,377	5,619	5,800	5,800
Net operating cash flow	-1,502	762	3,684	8,520	14,568	18,424	19,749	21,305
- total investments (CAPEX and WC)	-3,752	-6,579	-6,714	-7,172	-7,605	-7,263	-6,296	-6,635
Capital expenditures	-2,900	-5,800	-5,800	-5,800	-5,800	-5,800	-5,800	-5,800
Working capital	-852	-779	-914	-1,372	-1,805	-1,463	-496	-835
Free cash flows (FCF)	-5,255	-5,817	-3,030	1,348	6,963	11,161	13,453	14,671
PV of FCF's	-4,762	-4,545	-2,041	782	3,485	4,816	5,004	4,704

All figures in EUR '000	
PV of FCFs in explicit period	22,083
PV of FCFs in terminal period	20,976
Enterprise value (EV)	43,059
+ Net cash / - net debt	12,456
+ Investments / minority interests	0
Shareholder value	55,515
Diluted number of shares	205,541
Fair value per share in EUR	0.27

Fair value per share in AUD 0.43 FX rate: 1 AUD = 0.63 EURO

	WACC	Terminal growth rate							
		0.5%	1.0%	1.5%	2.0%	2.5%	3.0%	3.5%	
Cost of equity	16.0%	13.0%	0.35	0.36	0.37	0.38	0.38	0.40	0.41
Pre-tax cost of debt	10.0%	14.0%	0.32	0.32	0.33	0.33	0.34	0.35	0.36
Tax rate	26.0%	15.0%	0.29	0.29	0.29	0.30	0.30	0.31	0.32
After-tax cost of debt	7.4%	16.0%	0.26	0.26	0.27	0.27	0.27	0.28	0.28
Share of equity capital	100.0%	17.0%	0.24	0.24	0.24	0.25	0.25	0.25	0.26
Share of debt capital	0.0%	18.0%	0.22	0.22	0.22	0.22	0.23	0.23	0.23
WACC	16.0%	19.0%	0.20	0.20	0.20	0.21	0.21	0.21	0.21

*Please note our model runs through 2030 and we have only shown the abbreviated version for formatting purposes

Source: First Berlin Equity Research



COMPANY PROFILE

OVERVIEW

“New space” technology company based in Luxembourg aiming to commercialise radio frequency (RF) data to improve security in the maritime industry Kleos Space S.A. (Kleos) is a young technology company aiming to operate nanosatellites capable of scanning the earth for RF emissions. All communication equipment emits RF signals. The company targets the global intelligence, reconnaissance and surveillance (IRS) market, focusing on the maritime security industry. Maritime security applications for Kleos include monitoring of illegal fishing, illegal immigration, sea smuggling and contraband (e.g. drugs smuggling) and environmental monitoring (e.g. illegal oil bunkering). Kleos currently has 14 employees, of which about 10 are active in technology development. The company is headquartered in Luxembourg and has subsidiary offices in the UK and Australia. The three countries are of high relevance for Kleos, considering that they have a large interest in “new space” connected to surveillance and defence activities.

Figure 2: Kleos Structure



Source: First Berlin Equity Research, Kleos Space S.A.

Strategic decision to base the headquarters in Luxembourg reflects huge interest and support of the country for “new space” activities Luxembourg is pushing to be at the forefront of the “new space” race. The country is strongly encouraging the growth of innovative space industry start-ups in Europe with funding and friendly regulations designed to support new business ventures (For more details see Luxembourg's space initiative: <https://spaceresources.public.lu/en.html>). As a result, in 2017, Kleos, Magna Parva and the Grand Duchy of Luxembourg entered into a Memorandum of Understanding (MoU) through which the Luxembourg Government warranted a grant for the development of the technology and geolocation intelligence systems. The grant amount was agreed at €2.0m, of which approx. €1.0m has so far been paid. Further grants can be applied for in the future.

Kleos has its roots in the space engineering company Magna Parva Ltd. Kleos was founded in 2017 as a spin-off of Magna Parva, a UK-based space engineering firm which has been developing technologies for space applications for about 10 years. Magna Parva is equally owned by its CEO Andrew Bowyer and its CTO Miles Ashcroft (49.65% each), and their family members (0.7% altogether). Over a period of about 3 years Magna Parva developed an exciting “new space” technology with high commercial potential using satellites to capture radio signals from the earth. Mr Bowyer and Mr Ashcroft decided to spin off the technology and join the new company, Kleos, as CEO and CTO respectively. Magna Parva transferred intellectual property (IP) for space technology as well as contribution in kind related to equipment, processes and systems to Kleos. As part of the transaction Magna Parva received 50m shares in Kleos, which equated to a stake of 46.90% (Mr Bowyer and Mr Ashcroft owned 23.45% each of Kleos). The transaction also stipulated license payments on the profit generated with the IP assigned to Kleos as follows:



- 5.0% for the period 1 January 2018 - 31 December 2020 (3 years)
- 2.5% for the period 1 January 2021 - 31 December 2030 (10-years).

Australian Stock Exchange IPO accompanied by a dual listing on the Frankfurt Stock Exchange in late 2018 opens door for access to new funds

In order to finance operations, particularly construction and launch of the first cluster of 4 scouting satellites but also marketing of RF data, the company decided to go public. Kleos listed on the Australian Stock Exchange (ASX) on 24 August 2018. The company raised approx €7.0m (AUD11.0m) through its IPO, thereby increasing the number of shares outstanding from 32.9m to 106.6m. Based on the per share issue price of AUD0.20 for the placement, the post-money valuation for the company equated to AUD21.3m (€13.4m), using an FX rate 1 AUD = 0.63 Euros. The placement included 4.0m options with an exercise price AUD0.30 and 3 year maturity issued to the financing advisor Hunter Capital, as well as performance related shares for management currently amounting to 29.5m. The overall dilution potential of these instruments therefore totals 33.5m shares. Assuming a successful achievement of goals, Mr Bowyer and Mr Ashcroft will own approx. 26.7% of Kleos each. In December 2018 the company initiated a dual listing on the Frankfurt Stock Exchange in Germany, in order to expand its investor base in the European region.

NEW SPACE TECHNOLOGY WITH DISRUPTIVE POTENTIAL

Kleos' technology can detect RF signals from space Kleos technology consists of proprietary algorithms which enable the detection and independent geolocation of RF signals from space. The technology includes specific knowledge and expertise related to the required detection equipment and most importantly the optimised position of clusters consisting of four microsatellites flying in a specific formation in Low Earth Orbit (LEO) at approx. 500 km above the earth. This technology offers new possibilities for surveillance and earth observation. The IP portfolio acquired by Kleos includes: trade secrets, designs and elements which are potentially registrable worldwide. We give a brief overview of the IP portfolio in the table below.

Figure 3: Kleos' technology portfolio

INTELLECTUAL PROPERTY	NEAR TERM POTENTIAL	LONG TERM POTENTIAL	TRADE SECRET	DESIGN	FUTURE PATENT POTENTIAL
Antenna position knowledge and optimisation	X	X	X	X	X
Signal discrimination methodologies	X	X	X	X	
Geolocation algorithms	X	X	X	X	
Multiple antenna formation geometry	X	X	X	X	X
Atmospheric effect mitigation	X	X	X	X	
In-space pultrusion		X	X		
Long deployed structure satellite control methodology		X	X	X	X
Structure dynamic behaviour		X	X	X	X

Source: First Berlin Equity Research, Kleos Space S.A.



The IP portfolio also includes a patent-protected technology (Patent GB2500786) with long term application that enables manufacturing using pultrusion in space. Pultrusion is a special technique for the production of huge carbon composite 3D structures. This technology has disruptive potential, since it would enable the in-space manufacturing of large structures such as radio antennae and synthetic aperture radar systems, which is sensitive equipment and difficult to transport to space. The company has already built a prototype which has been successfully tested under 'near space' conditions.

COMPANY HISTORY

Table 1: Key milestones in Kleos' history

Time	Corporate events
2015-2017	Engineers at the UK-based engineering company Magna Parva Ltd conducted R&D on geolocation of earth radio frequency (RF) from space, leading to the generation of new IP.
August 2017	Magna Parva management which became managers and founders of Kleos recognised the potential of the RF geolocation technology and decided to spin off the technology. Kleos was founded and took over the IP in exchange for shares and royalty payments on future profit.
November 2017	Kleos signed a MoU with the government of Luxembourg which committed to pay €2.0m grants for development of space technology. The government of Luxembourg receives worldwide free license on the IP generated with the funds.
February 2018	The company conducted a seed financing round raising €1.4m.
August 2018	Kleos carried out a listing of the company on the Australian Stock Exchange (ASX) and conducted a private placement that secured the company new funding of €7 million before costs. These funds will finance the construction and launch of the first satellite constellation scheduled for the end of Q2/19 as well as marketing activities of the RF data.
July and September 2018	Kleos signed a contract with Gomspace to supply the scouting system consisting of 4 nanosatellites for €2.4m. Two months later the company signed a contract with Rocket Lab to launch the scouting satellites.
August and December 2018	The company signed its first two MoUs with Airbus Defence and Space and with Ball Aerospace, to explore cooperation opportunities related to RF data.
November-December 2018	The company signed two MoUs for distribution partner agreements with the analytic specialists Orbital Insight (US) and Intelligence Management Support Services (UK) to integrate Kleos data in their platforms.
December 2018	Kleos conducted a secondary listing on the Frankfurt Stock Exchange in Germany.
March 2019	Kleos signed a distribution partner agreement with the US defence company Victoria Falls technology LLC, which intends to market Kleos data with the US Air Force. This deal has a sales potential of USD750k-3m over a 1-2 year period starting in 2020.
March 2019	The company signed an MoU for a distribution partner agreement which would allow the intelligence and analytic specialist Image Sat International N.V. (ISI) to integrate Kleos' data in their platform.

Source: First Berlin Equity Research, Kleos Space S.A.



NANOSATELLITES OPERATOR SCANNING FOR RF SIGNALS

BECOMING A NANOSATELLITE OPERATOR

Operating nanosatellites to scan for RF signals, which are valuable to improve security in the maritime industry The company aims to launch and operate its own nanosatellite constellation consisting of clusters of four satellites flying in a predetermined formation in Low Earth Orbit (LEO) at approx. 500 kilometres from earth. From LEO, the satellites will scan the earth for RF signals. The company estimates that it will require 10 clusters of satellites to cover the earth in a highly efficient way, being able to scan required areas every 10-15 minutes. The main focus of the satellites is to collect radio frequency (RF) signals emitted by devices within the maritime industry, in order to generate valuable commercial intelligence data. Kleos intends to sell Data as a Service (DaaS) worldwide. Potential customers are government agencies, intelligence organisations, or businesses interested in locating specific ships or transport vessels. Typical use cases for the DaaS will be fields such as security, maritime protection, border controls, environmental protection, search and rescue services and insurance.

Buy or build?...Buy is the best option Following a build or buy analysis, the company decided to outsource the satellites design, production and launch. This decision has the advantage that Kleos has a more focused business around its core technologies and maximises its chances of success. The required satellites are developed, built and launched by specialised space companies which are leaders in their respective fields and benefit from state of the art technology expertise and economies of scale.

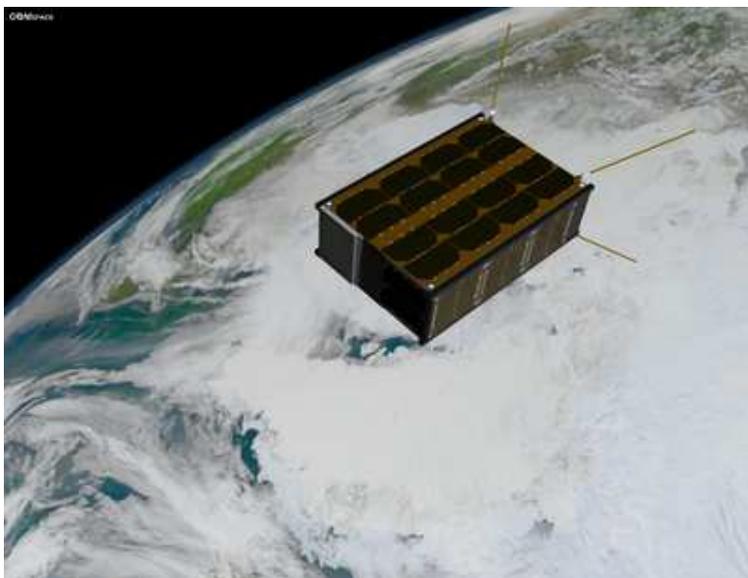
GomSpace, a leading nanosatellite manufacturer on track to deliver the first nanosatellite system by Q2/19 The scouting satellites will be supplied by GomSpace A/S, a leading producer and operator of nanosatellites and nanosatellite components (payloads such as ship tracking equipment and subsystems such as power supplies, propulsion, computers, batteries, solar panels, etc.) based in Denmark. The closed purchase agreement for the first scouting system consists of 4 fully equipped cube nanosatellites amounts to approx. €2.4m.

The ordered nanosatellites are fully equipped to scan the earth and geolocate RF signals The nanosatellites ordered by Kleos belong to the 6U CubeSats type with a size of about 10cm x 20cm x 30cm, have a cube form which explains the name, and have an operational life of 3-5 years depending on the use. The satellites are equipped with payloads that have the capability to collect and geolocate radio waves of very high frequency (VHF) as well as AIS transmissions (ships and vessels usually report their position using AIS systems) coming from the earth. Kleos will be able to compare the results from ships' self-reported AIS geolocation to their own measured VHF geolocation and discover vessels that are either deliberately misrepresenting their true location or are not sending signals so as to stay unidentified. The closed contract includes R&D, test equipment and launcher integration support which altogether we estimate to cost about €1.0m. As a result, we believe that follow up 4-nanosatellite systems can be purchased for approx. €1.4m. The agreement does not foresee any exclusivity, which means that Kleos can freely chose the provider for the next purchases. We currently view GomSpace as the top provider offering best quality and price. The delivery of the first system and launch to space is planned for the end of Q2/19.

Kleos sends the RF data to a ground station for processing The RF data captured by the scouting satellites are sent via radio waves to a strategically located ground station network. We anticipate that Kleos will rent this service from a leading provider in the field. A key consideration here will be that the provider has a worldwide network of ground stations

and remotely controlled antennas. Kleos will access the data from the ground stations, process it and deliver it to its customers through its web platform Guardian ABI.

Figure 4: Gomspace nanosatellite



Source: First Berlin Equity Research, Gomspace A/S

Rocket Lab, the market leader in nanosatellite launches, will place the first scouting satellite cluster in orbit by the end of Q2/19 The rocket launch will be conducted by Rocket Lab. Based in Huntington Beach, California, Rocket Lab in 2018 became one of the top companies offering advanced rocket technology and services to launch small satellites into orbit. The company's flagship Electron rocket is capable of delivering satellites of up to 150 kg to a 500 km sun-synchronous orbit at an unprecedentedly low cost. The launch service costs approx. €1.4m. The satellite launch on an Electron rocket from Rocket Labs' Complex-1 station in New Zealand is scheduled for the end of Q2/19. Kleos is contractually tied to Rocket Lab for the first launch only and has the option of subsequently choosing a new launching partner. Kleos has prime contractor status with Rocket Lab, which gives it the right to determine the date and time of launch and the optimal orbital trajectory. For the time being, Kleos considers it important to be have prime contractor status in order to have full control of the launch. A potentially cheaper alternative in the future could be joining a ride share.

Once in space, the scouting satellite system will undergo a set up and validation stage which will take 1-2 months. At this stage the satellites are positioned in the correct orbit and formation and the radio frequency geolocation equipment is calibrated. After this, Kleos will be able to collect data and generate SaaS revenues. The scouting satellite launch is a key milestone for Kleos, as the company will demonstrate its ability to sell the data.

Insurance covers launch risks The company has taken out a 5 year insurance policy which covers the satellite and the launch for €377k. According to statistics, the satellite launch failure rate is estimated at approx. 5% (e.g. Space-X's Falcon 9 with 1 failure in 19 launches). Moreover, success rates of validated nanosatellite producers and launch operators in this niche which have passed the experimental stage can be even higher (e.g. Lockheed Martin's Atlas V with 98%).



First scouting nanosatellite system able to generate revenues. The constellation may grow to up to 20 systems depending on customer demand Kleos estimates that the first scouting satellite system will provide daily data refresh rates. This data will already be useful for potential clients, which is why the company will be able to generate sales in the first months after launch. The more satellite systems in orbit, the more frequently the same geographic area of the globe can be scanned leading to higher refresh rates. Kleos has determined that the optimal number of satellite systems from an operational perspective is up to 20, which will provide near real-time scanning of the earth. The ramp-up rate to build the satellite constellation will be driven by customer demand (contract volume as well as required revisit rate of a satellite for a specific geographic point of interest) and funding. Over the next years, Kleos intends to launch additional satellite systems. The current plan is to add about two satellite systems per year starting in 2019 growing the constellation to approx. 10 systems by 2024/2025. However, in the case of very strong demand and immediate full funding, the company could expand the satellites constellation to the maximum of 20 systems within only 2 years.

MOST LEGAL REQUIREMENTS FOR SATELLITE OPERATION TO BE MET SHORTLY

Engineering and technological hurdles are not the only challenges to overcome in order to become a small satellite operator. A company such as Kleos needs to meet legal and regulatory requirements, which include the operating concession from the Government where the company is based and further licenses and permits. Kleos has applied for a concession from the Luxembourg Government to establish and exploit satellite systems in accordance with the local Electronic Media Law and an approval is expected by May 2019. In keeping with standard practice, Kleos' operations will be closely monitored by government commissioners and the company is obliged to notify all relevant changes in ownership to the authorities (e.g. shareholders holding >10% of company's stock).

Kleos also needs a license to use frequencies for the transmission and reception of radio frequency signals from the Luxembourg Institute of Regulators (ILR). The company has also applied for the licence for the use of electronic communications networks and services and the approval is anticipated by May 2019. Furthermore, Kleos must register with the International Telecommunication Union (ITU). The registration process is underway and the company anticipates obtaining the registration with the ITU by May 2019, before the rocket launch takes place.

USEFULNESS OF RF SIGNALS FOR TRACKING SHIPS

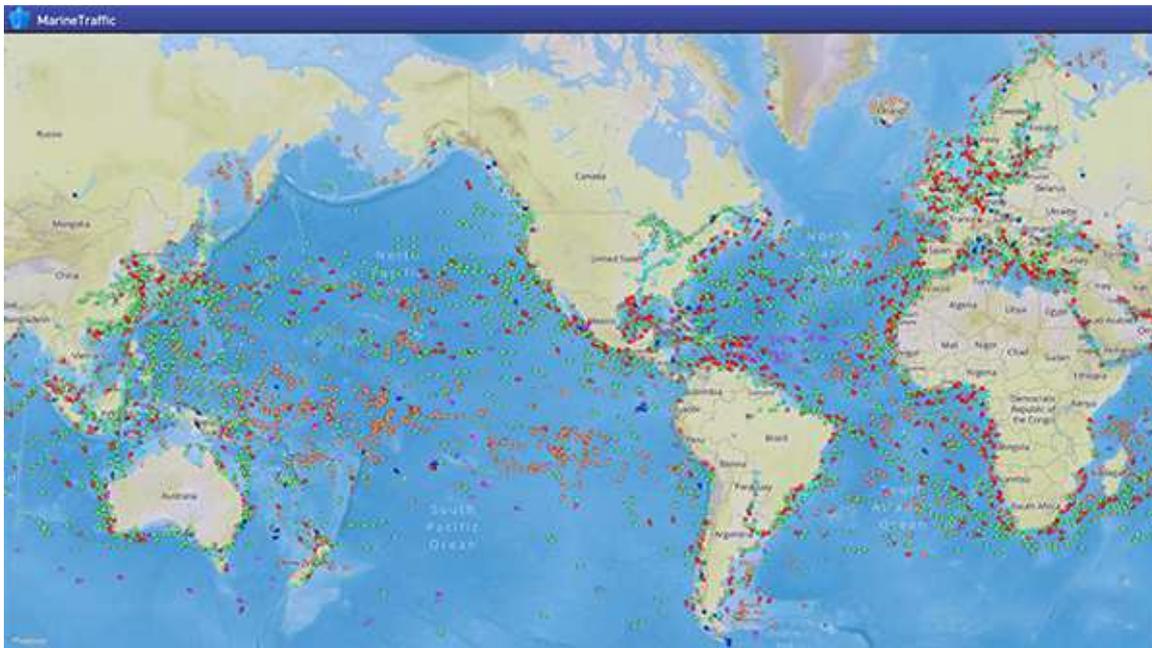
CURRENT APPROACHES TOWARDS MARITIME SECURITY

International governments represented by their respective Defence and Security institutions, are interested in securing their home waters (particularly island countries such as UK, Japan or Australia) and a well-functioning and secure maritime industry. These organisations already use geospatial observation techniques for the identification and tracking of threats at seas. At present, four main types of geospatial technologies are used to track ships from space:

- Automatic Identification System (AIS)
- Geo Positioning System (GPS)
- Optical imagery (OI) – includes pictures and videos
- Synthetic Aperture Radar (SAR)

The AIS is an automated tracking system which is extensively used in the maritime industry for the exchange of navigational information between AIS-equipped terminals such as ships, ground stations or satellites. The International Maritime Organisation (IMO), which initially developed the system to avoid ship collisions, requires that all passenger and commercial vessels of 300 gross tons upwards travelling in international waters have to carry AIS equipment capable of transmitting and receiving AIS data. Vessels with AIS systems usually also include a GPS (Global Positioning System) receiver which records the subject vessel's position and movement details. Based on this AIS/GPS system and the exchange of the data generated it is possible to track all ships and vessels trafficking worldwide in real time (Follow it at: www.marinetraffic.com).

Figure 5: Life visualization of AIS-signals from ships worldwide



Source: First Berlin Equity Research, Marinetraffic.com

However, the AIS/GPS system has some shortcomings. Given that the AIS is a self-reporting system, it is susceptible to manipulation. The user is able to switch it on and off at his convenience, potentially to engage in illegal activities (e.g. drugs or weapons trafficking, illegal fishing, illegal immigration, illegal oil bunkering, etc.). Considering that signals interruptions are common due to channel-related effects (e.g. vessel range out of Line-Of-Sight (LOS), fading, multipath, shadowing, etc.), it is difficult to identify intentional signal interruptions. On the other side AIS/GPS signals can be easily jammed (noise generators distort or block the signal) and spoofed (generate signals that can lead receivers to output an incorrect or a desired position). This situation raises problems for tracking ships and identifying the ones which do not want to be tracked.

Satellite observation using OI and SAR for maritime applications provides powerful tools to monitor potential security concerns. While OI can produce a very detailed image of a certain sea area or maritime target, it has weather (obscured by clouds) or light (requires daylight) limitations. SAR, while it does not have the resolution of OI, has the advantage that it is a weather- and illumination-independent imaging process. Therefore, these two technologies are complementary to resolve maritime threats. However, a remaining unresolved issue is to identify the right targets for the satellites to observe. In this task the new technology based on RF signals can provide the missing piece of information. We give an overview of the three existing technologies in the table overleaf.

Table 2: Overview of sensing technologies and their commercial use

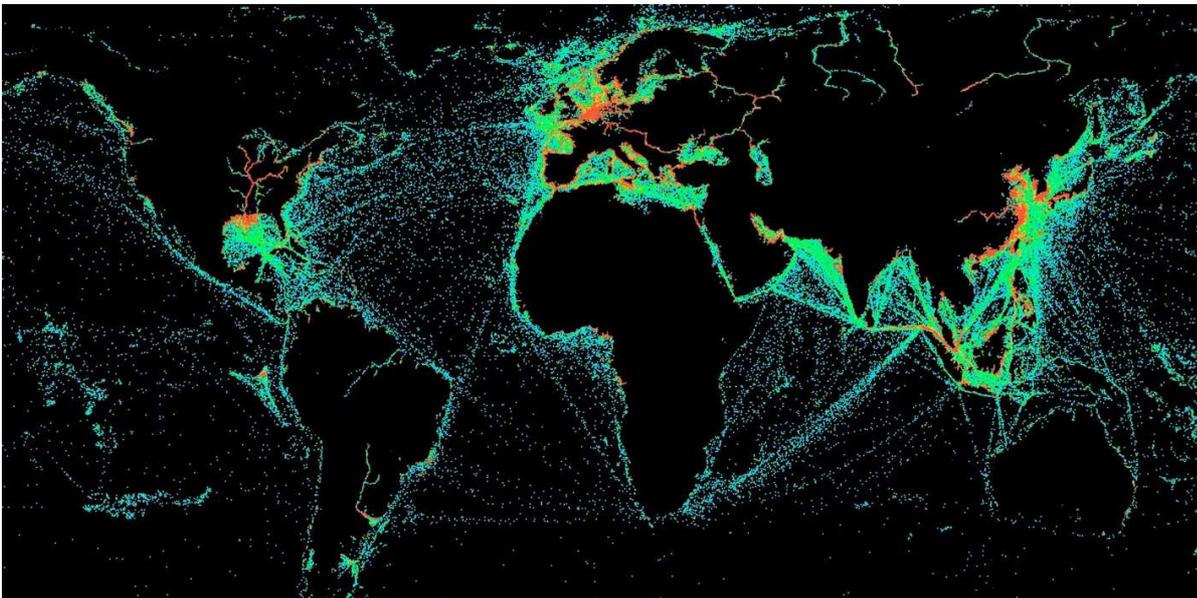
DATA COLLECTION METHOD	OPTICAL	RADAR	RF SIGNALS
AIRCRAFT (incl. drones)	X	X	X
SATELLITE	X	X	Launch underway*
GROUND OBSERVATION	X	X	X

*There are currently only two companies launching satellite RF data applications: HawkEye360 and Kleos

Source: First Berlin Equity Research, Kleos Space S.A.

RF SIGNALS OFFER COMPLEMENTARY APPROACH FOR MARITIME SECURITY

Standard marine communication (e.g. push-to-talk radios) and navigation equipment (e.g. marine radar) use radio waves which transfer RF electromagnetic energy. Other sources of radio waves include satellite communication devices, mobile phones and their base stations, etc. Based on Kleos' RF tracking technology, the company can detect and geolocate RF signals from vessels worldwide. The main advantage of the system is that the instruments being tracked are essential for the ships' navigating activities and cannot be waived, disconnected, spoofed or jammed. By combining the signals with a mapping card similar to google maps, the company can create a map with the "fingerprint" of vessels. We give an example of how the mapping screen could look in the figure below.

Figure 6: Example of a Visualization of RF signals from ships on the map

Source: First Berlin Equity Research, HawkEye³⁶⁰

Effective management of Maritime Security activities requires the capability to collect all types of available geospatial data and merge the data into a common and comprehensive picture Through RF tracking of maritime traffic over time and the use of artificial intelligence algorithms, the company would be able to identify single vessels and their normal activities, identify suspicious patterns or anomalies, and even forecast future movements. In addition, the company's system is designed to combine and compare the measured AIS/GPS data with the RF data to identify differences. For example, the system will issue an alert when a RF signal is not accompanied by an AIS/GPS signal (when devices are turned off). The system will also be able to identify and track "dark vessels" more closely if illegal activity is suspected. Similarly, if a ship is "spoofing" its AIS location, the RF fingerprint



will reveal its true location. In order to create 100% certainty as to what is happening on the vessels, probably the best option would be to forward the suspicious candidates to optical or radar observation. We therefore see the existing observation technologies as complementary.

At present, geolocation of RF signals is expensive and challenging to achieve, satellites offer new opportunities RF tracking is currently being conducted in selected cases from ground or from large aircraft (drones). However, detection from the ground is limited by the horizon 3-mileradius at eye level. Air-based tracking (Airborne ISR) is expensive, and technically limited in range (limited to 12 hours of coverage without air refuelling), persistence and by weather. Furthermore, the need for operating bases close to the areas of interest also represents a challenge (source: Kleos).

THE RF DAAS PRODUCTS

GUARDIAN ABI – WEB PLATFORM FOR CUSTOMERS’ DATA ACCESS

Kleos has developed a platform called Guardian ABI to distribute the DaaS products. The Guardian ABI platform to give clients access to the DaaS product is completed and ready to integrate data from the scouting satellite. Kleos’ team of engineers and programmers based in Luxembourg has created a consumer facing web platform to stream the data. The Guardian ABI platform will display the data via a “Google Maps”-like interface. In addition, the company will offer Application Programming Interfaces (API) so that customers can download the data to their own analysis or intelligence platform. In this way clients can create value-added applications for the platform leveraging the extensive data set to create new functionality and meet their own intelligence requirements. Clients will be able to select geographic areas of interest and based on their own data requirements they can buy access to a specific product through a subscription package.

OVERVIEW OF PRODUCT TYPES

Kleos’ Guardian ABI will offer four products with different levels of data access. The most basic product, Guardian RF, includes the raw RF data with transmitter location and time. More structured products Guardian LOCATE and Guardian UDT provide mapped visualization with either global or data customized for a specific region or other feature of interest. The most complex product, Guardian INTELLIGENCE, includes analytics features comparing the raw RF data with additional data sources such as AIS, procured third-party imagery (pictures/videos) and weather. Powered by complex artificial intelligence (AI) algorithms, this product will offer insight into specific targets’ actions, capabilities, and forecasted intentions often long before they act. We give an overview of the four products in the table below.

Table 3: Overview of the four DaaS product types accessed via Guardian-ABI

FEATURES	Guardian RF (raw data)	Guardian LOCATE (mapped global)	Guardian UDT (mapped customized)	Guardian INTELLIGENCE (mapped & AI-analytics)
Global, Daily Data	X	X		X
Specific area of interest			X	X
Mapped Visualisation		X	X	X
AIS filter enabled		X	X	X
Imagery selection enabled		X	X	X
Encrypted		X	X	X
Geolocation accuracy 200m-3km		X	X	X
AI-powered analytics				X

Source: First Berlin Equity Research, Kleos Space S.A.



Overall, the four product levels take the different preferences that clients' usually have into consideration. Some clients will prefer to buy the raw data as they typically have internal intelligence capabilities and may want to conduct their own analysis on the data. Other users will prefer to purchase higher value intelligence information meeting their requirements. As the number of satellites added to the constellation increases, the value of the products offered will also increase. A higher refresh rate will allow more accurate intelligence and forecasting capabilities. Given that Guardian INTELLIGENCE will generate the highest profitability, the company's goal will be to maximise the number of clients buying this product. However, Guardian INTELLIGENCE's analytics features generated with AI are still under development. Kleos will increase its man power of data scientists in the course of the year, enabling the company to have the product ready for sale towards mid-2020.

CLIENT PIPELINE

Kleos plans to distribute and sell the satellite-generated RF data directly to end users such as governments and maritime companies as well as to distribution channel partners such as large old space companies (e.g. Airbus aerospace) and data analytics companies which will sell the data to their end customers. Kleos expects a client mix of roughly 50:50 between end customers and distribution partners. The company is currently a European pioneer in offering RF data to government and commercial customers outside the US.

In advance of the launch of the first satellites, Kleos has built up a pipeline of companies interested in purchasing selected maritime RF data. Kleos has closed 5 memorandums of understanding (MoUs) and 1 distribution agreement. The distribution agreement will include potential development revenues of USD750k-3m.

Table 4: Overview of contracts pipeline to market RF data from satellites

US	Deal type	Country	Partner description	Deal comments
Orbital Insight (OI)	MoU	US	The company develops geospatial data analytics to unlock societal and economic trends for clients	Non-exclusive channel partner agreement Preparation to integrate Kleos' RF data into OI's platform is underway
Intelligence Management Support Services (IMSL)	MoU	UK	Intelligence and analytics specialist offering services to government and industry customers globally	Non-exclusive channel partner agreement. IMSL will include Kleos' data in its platform to offer superior analytics services
Airbus Defence and Space (ADS)	MoU	Netherlands and Europe	European aeronautic defence and space company	Non-binding agreement to explore cooperation areas
Ball Aerospace (BA)	MoU	US	Aerospace defence and intelligence contractor	Non-binding agreement to explore cooperation to market Kleos' data
Victoria Falls Technology LLC (VFT)	Agreement	US	Young company specialised in offering services for US defence programmes	If the US Air Force buys the VFTs service as expected towards 2020, the deal implies development revenues for Kleos in the range USD750k-3m
Image Sat International N.V. (ISI)	MoU	Israel	Global leader in geospatial intelligence solutions for defence and intelligence customers	Non-exclusive non-binding agreement. ISI will include Kleos' data in its platform to offer superior analytics services for the maritime sector

Source: First Berlin Equity Research, Kleos Space S.A.



ON TRACK TO GENERATE REVENUES

Based on the pipeline, we recognise that there is client interest in the RF data. The majority of the first clients are pursuing the integration of Kleos's RF data to offer it through their platforms to their end users. While the majority of MoUs do not mention any deal values, we conservatively estimate that the company can generate at least some €300k-1.0m revenues per client per annum. As a reference, "new space" companies using nanosatellites equipped with optical technology to track several industries have typically closed deals worth at least USD 1.4m or €1.2m (e.g. US National Oceanic and Atmospheric Administration-NOAA awarded contracts in September 2017 for data from Spire Global Inc. for USD1.4m, from GeoOptics for USD3.4m and Planet IQ for USD3.5m). We expect that the MoUs will translate into purchase agreements shortly after the satellite is successfully launched and placed in orbit towards the end of Q2/19. We also believe that this event will be a trigger to attract the attention of many potential customers and facilitate the acquisition of new clients. We therefore anticipate that the company will be able to close DaaS contracts and generate an order backlog worth a few Euro million during Q3/19 and Q4/19.

"NEW SPACE" ECONOMY

In this chapter we briefly give an introduction into the "new space" economy, we describe satellites and nanosatellites in the context of the new space race, to understand why scientists and private companies are increasingly active in space.

TRANSITION FROM "OLD SPACE" TO "NEW SPACE" ECONOMY

"Old space" economy was largely driven by governments and defence departments

The space economy can be defined as "the full range of activities and the use of resources that create and provide value and benefits to human beings in the course of exploring, understanding, managing and utilising space" (source: Space Safety Magazine). Historically, space exploration has been the domain of states and governments. Development in the old space economy was to a large extent driven by a competition between the Soviet Union and the US to demonstrate space dominance. As a result, in the past decades military customers were direct drivers of the introduction of all major applications in space technology, such as remote sensing, navigation, manned and unmanned space flight, earth observation, and communication (source: Barbaroux et al. 2013). Although military and government are still the main customers and a relevant source of revenue for the space industry, major new business prospects from commercial applications of the developed space technologies are gaining momentum. Moreover, today over 75% of space activity comes from the private sector (source: Space Foundation 2016)

The "new space" industry is currently experiencing an innovation-driven paradigm shift

Space systems have become smaller, cheaper, and lighter than legacy technology (Whitney, 2000). Transformative technological changes such as integration of breakthroughs in micro-electronics leading to miniaturisation of spacecraft (e.g. small satellites - Nano CubeSats) and payloads, innovation in ground stations' capabilities and arrival of reusable rockets technology based on vertical landing are transforming the space industry (source: Petroni, Santini, 2012). For example, reusable rockets have rapidly become established as part of Space X' and Blue Origin's business model. New technologies have enabled drastically falling launch costs. In the 80's and 90's NASA's space shuttle (27,500 kg) programme run from 1981-2011 had a cost per launch of about USD1.5bn or USD54,500/kg to launch to LEO, compared to SpaceX's Falcon 9 (22,800 kg) now having a cost of USD62m or USD2,720/kg for launch to LEO. This equates to a reduction in cost per kg by factor 20 (source: Jones et al, 2018). The new Space X Falcon Heavy is anticipated to reduce costs even further to about USD1,700 per kg (based on announced launch costs of USD90m for a 63,800 kg payload). As

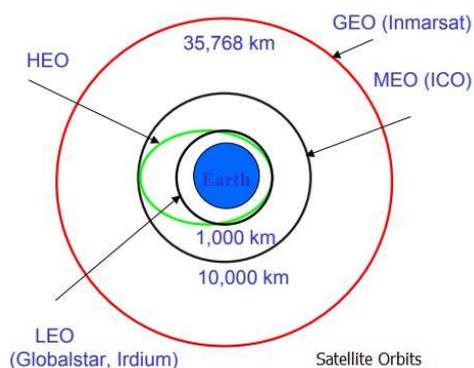
a result, SpaceX has emerged as a key rocket producer, providing direct competition to the United Launch Alliance of Boeing and Lockheed Martin, so far contractors of choice for NASA and the Department of Defence in the US. All these events have marked the transition to the so called “new space” economy or “space 2.0”, where an increasing number of private companies with new business models (e.g. small satellite production, satellite servicing, space tourism, exploiting natural resources from space, etc.) get engaged in space activities. Business prospects for the space industry look promising. This industry was valued at USD360bn in 2018, projected grow at a CAGR of 5.6%, to USD558bn by 2026 (source: ReportBuyer.com).

“New space” attracts significant private financing Based on the new, lower entry cost to space and the expectation of bright business opportunities, “new space” is being fuelled by investment from well-known billionaires such as Elon Musk with Space X, Jeff Bezos with Blue Origin, Sir Richard Branson with Virgin Galactic and OneWeb, Bill Gates with Kymeta, etc. (source: Forbes). Furthermore, Mr. Bezos who is the Amazon founder and the wealthiest person worldwide once said that he “sees a dynamic, entrepreneurial explosion in space just as we witnessed over the last 20 years on the internet”. According to Space Angels, over USD16bn has been invested in space-related start-ups and established companies since 2000. In 2018 alone, venture capitalists invested USD3.3bn in space technology companies (source: Seraphim Capital).

SATELLITES

Satellites, space and orbits A satellite is generally defined as a smaller, space-based object moving in a loop, a so-called orbit, around a larger object, which can for example be the earth. The most widely accepted definition of the “edge” where space begins is 100 kilometres above the Earth’s surface (e.g. the Fédération Aéronautique Internationale – FAI, which is the world governing body for air sports and also stewards definitions regarding human spaceflight). Artificial satellites built by humans need to be transported by a rocket to space. Once in space, they are placed in a travel trajectory around the earth - a so-called orbit (see figure 7).

Figure 7: Earth satellite orbits



Source: First Berlin Equity Research, Javatpoint.com

The Low Earth Orbit (LEO) Low Earth Orbit (LEO) is reached at an altitude of between 180 - 2,000 km from earth (source: Nasa - New space: The emerging commercial space industry). As LEO requires the lowest amount of energy for satellite placement, it is more easily accessible and provides low communication latency (satellites therefore require less powerful amplifiers for transmission). However, based on the relatively low altitude, the satellites have a small field of view and therefore require a network of many satellites (constellation) to cover the earth. They also experience faster orbital decay (satellite slows down and gravity pulls them towards earth), requiring periodic reboosting (e.g. using propulsion) to maintain a stable orbit trajectory (source: www.spacelegalissues.com). Based on the easy access, most scientific research satellites, such as the International Space Station (ISS) and the Hubble



Space Telescope are located in LEO. A satellite located in LEO has a very short orbital period between about 84 and 127 minutes. This is the time a satellite would take to complete one orbit around the earth. The main reason is that a LEO satellite will be moving very fast in order to overcome Earth's gravity. Based on the speed and the relatively small orbit due to the short distance to the Earth, a LEO satellite spends a very short time over a certain point of the earth.

Medium and High Earth Orbits (MEO and HEO) Travelling further from earth are the Medium Earth Orbit (MEO) satellites at an altitude ranging from 2,000km to less than 35,786km. The orbital period of MEO satellites ranges from about 2 to 12 hours. The High Earth Orbit (HEO) begins at the distance of 35,786km, which is the exact distance at which the Geosynchronous (the orbital period is exactly one day, enabling the satellite to visit the same position every day at the same time) and the Geostationary (satellite matches earth rotation and stays in the same position above the earth) orbits are located (source: www.spacelegalissues.com).

Use of satellites At present, satellites usually carry a wide range of equipment and instruments capable of producing a large amount and variety of information. The three main uses of satellites are:

- Communications (e.g. telephone, TV, etc)
- Imaging and surveying (e.g. for scientific, weather forecasting or government defence purposes)
- Navigation (e.g. GPS)

NANOSATELLITES & CUBESATS

Small satellites Small satellites are an emerging class of spacecraft, which have been generating increasing interest in the industry since 2012. According to Bryce Space & Technologies, over 1,300 small satellites have been launched into space since 2012, and 2018 saw 6x as many launched as in 2012. They have significant advantages over traditional satellites such as shorter development and production cycles and the participation of smaller development teams. Advances in technology and computer chips have enabled substantial shrinkage of the size of satellites, while at least maintaining if not improving the performance of their predecessors. This industry is experiencing similar technological and miniaturisation trends to the computer or communication industry. Today, a small satellite the size of a toaster can perform similar tasks to a satellite the size of a car 20 years ago. As a result, small satellites benefit from significantly lower costs compared to conventional alternatives. The small satellite market is estimated to grow at a CAGR of 17.1%, reaching USD6.9bn by 2023 (source: Mordor Intelligence, 2019). Based on their size, small satellites can be classified as follows:

Table 5: Classification of small satellites based on their size

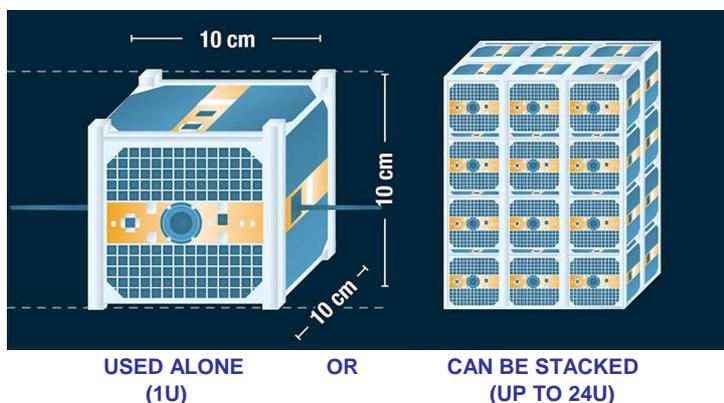
Type of spacecraft	Kilograms (kg)
Femto/Pico satellite	0.01 – 1
Nano satellite (CubeSat)	1.1 – 10
Micro satellite	10.1 – 200
Mini satellite	201 – 600

Source: First Berlin Equity Research, Bryce Space and Technology

Nano satellites & CubeSats account for the largest proportion of satellite launches

Nano satellites, which have a mass of 1.1-10.0kg, have become the favoured small size satellites of universities, education institutions and emerging commercial companies (start-ups). A total of 950+ Nano satellites or so called CubeSats were launched into space in the period 2012 to 2018, equating to over 70% of small satellite launches. Nano satellites and CubeSats are expected to consolidate their dominant position in the satellite market. (source: Brice Space and Technology). Space Science Professor Bob Twiggs from Stanford University was the pioneer in creating and promoting the new concept of CubeSats which ended up prevailing in the overall small market segment. According to his concept, CubeSats are standardised, built in a cube form 10cm x 10cm x 10cm weighing about 1kg. Depending on use and requirements, they can be stacked together building a corpus of up to 24 units (See figure below).

Figure 8: Cube Sats



Source: First Berlin Equity Research, Canadian Space Agency

Nano satellites becoming a “game-changing” technology in new space There are several other relevant features which are attractive about CubeSats for commercial purposes. A commercial CubeSat usually has a payload (radio communication system with antenna and a computer to execute instructions), a power source (battery) and a propulsion system. They use standard off-the-shelf components with simple design which allow for faster development and production. Therefore, CubeSats are built at a relatively low cost with a planned operating life up to 5 years, so that by replacing the Cubesats the operator gains an upgraded state-of-the-art technology (this is in accordance with current shorter technology life cycles). The Cube form significantly eases planning for rocket transportation compared with non-standard form satellites. Typically CubeSats are conceived to travel to LEO. Therefore accessibility and transport costs are also relatively low. Leading launch providers, such as Virgin Orbit, Vector Launch and Rocket Lab already offer share rides, and there is already competition from Spaceflight Industries (SpaceFlight.com), a company specialising in re-selling share rides. Finally CubeSats do not cause space debris (space waste), since at the end of operational cycle, operators de-orbit the satellites and they burn in the earth’s atmosphere.

The business model of Small satellites/CubeSats relies on a large number of satellites flying in predetermined constellations (at easy to access LEO) which are capable of covering the whole earth. These satellites are mainly designed to perform tasks such as earth observation for optical, radar or RF sensing, weather monitoring, internet beaming, etc. The main value of the satellite constellations lies in the terrestrial processing and selling of data. Constellations of CubeSats and small satellites appear to be on the verge of scaling up considerably (source: OECD). There are several technology companies planning to create small-satellite constellations from less than hundred to several thousand satellites. We give an overview of some of them in the table overleaf.

Table 6: Satellite constellations in selected emerging applications

COMPANY	CONSTELLATION NAME	TOTAL NUMBER OF SATELLITES	APPLICATION
SpaceX	Starlink	11,943	Internet beaming satellites
Amazon	Project Kuiper	3,236	Internet beaming satellites
OneWeb	OneWeb	600	Internet beaming satellites
Telesat	-	292-512	Internet beaming satellites
Leosat	-	Up to 108	Internet beaming satellites
HawkEye ³⁶⁰	-	Up to 30	Offering Intelligence based on RF data
Kleos Space	-	Up to 80	Tracking RF data, offering intelligence

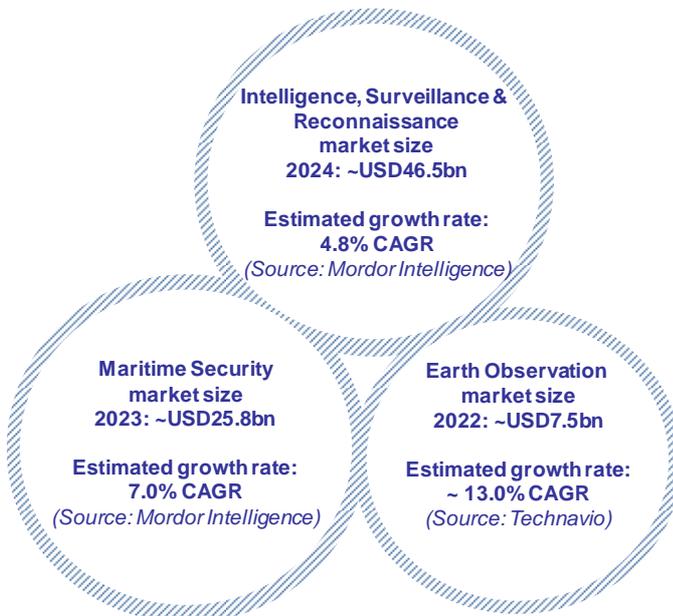
Source: First Berlin Equity Research, Techspot, Spacenews, companies

MARKET & COMPETITION

MARKET

Kleos targets the government (i.e. defence) and commercial intelligence, surveillance and reconnaissance (ISR) market focusing on the maritime security (MS) segment, offering Data as a Service (DaaS). Given that Kleos' satellites-based approach to generating RF DaaS is new in the market, we also view the space-based earth observation (EO) market as relevant. We believe Kleos' target market represents an intersection of the ISR, MS and the EO markets. These markets give a good proxy to estimate the dynamics of Kleos' targeted market as well as sales potential of Kleos' products.

Figure 9: Relevant target markets



Source: First Berlin Equity Research, Mordor Intelligence, Technavio,

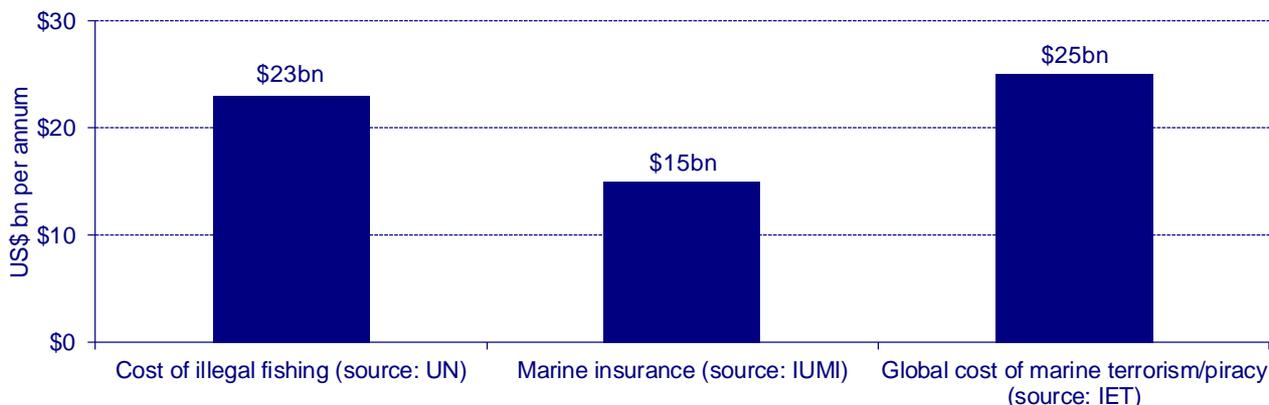
Intelligence, surveillance and reconnaissance (ISR) are essential to enable governments and companies to make timely and correct decisions The users of ISR data are predominantly governmental defence, security agencies and selected private companies. Increasingly complex threats and emergencies are driving the demand for ISR data. They are an essential asset when dealing with emerging global threats.



Overall ISR market is expected to grow at mid-single-digit CAGR The ISR market is anticipated to reach over USD46.5bn by 2024, growing at a CAGR of 4.8% during the forecast period. Growth is expected to be mainly driven by adoption of ISR practices by an increasing number of countries, as well as new technologies entering the market. Space-based systems (satellites) in particular are anticipated to attract attention from market participants and will likely produce the largest dynamic in this industry (source: Mordor Intelligence, 2019).

Maritime security (MS) of high relevance for international economies due to huge losses to the industry The United Nations (UN) considers maritime transport a backbone of world trade and globalisation. According to the UN Review of Maritime Transport for 2018, global maritime trade increased by 4% in the year transporting 10.7bn tons. The International Maritime Organization (IMO) also states that sea transport is by far the most cost-effective way to transport goods and raw materials around the world, which is why over 90% of all world trade is carried by sea transport with an increasing tendency. As a result, security is an increasing concern in the maritime industry. Modern maritime security involves the use of advanced technologies to detect danger and raise alerts well in advance in order to avoid intended damage to the maritime industry including ships, ports, governments, transported people and goods, etc. At present, activities such as maritime terrorism (e.g. US warship Cole at port Aden, Yemen, French tanker Limburg off the Yemen coast) gun-running, drug trafficking, piracy (e.g. coasts of Somalia and Indonesia, the Straits of Malacca), illegal fishing, and other non-traditional seaborne attacks have increased strongly and threaten many countries worldwide (source: Mordor Intelligence). The cost of illegal activities in the maritime industry represents a large burden to the worldwide economy (see figure below).

Figure 10: Cost of selected illegal activities in the maritime industry



Source: Kleos Space 2018

MS market to achieve high single-digit percentage rate growth The global maritime security market was valued at USD17.1bn in 2017 and is expected to reach USD25.8bn by 2023, growing at a CAGR of 7.0% during the forecast period 2017-2023. Based on the large losses incurred through illegal activities, maritime security has become a key challenge for many governments, agencies and companies. Growing awareness of increasing threats to sea transportation, as well as technological advances and new integrated solutions are described as key market growth drivers (source: Mordor Intelligence, 2018).

Earth Observation (EO) market worth USD2.2bn in 2017 and expected to show double digit percentage rate growth According to the 2018 Satellite Industry Association Report, in 2017 global space-based observation data product revenues amounted to USD2.2bn (+10% y/y). The intelligence company Technavio projects the satellite-based earth observation market to amount over USD7.5bn by 2022, growing at a CAGR in excess of 13% in the forecasting period.



Kleos' target maritime information market estimated at USD 1.4bn by 2020, growing at a CAGR >10% Kleos' product portfolio is focused on the information (data and intelligence) segment of the ISR and MS markets. Technavio projects that the global maritime information market will be worth USD1.4bn by 2020, showing a CAGR of over 10% in the period 2018-2022. Furthermore, according to the satellite intelligence provider HawkEye³⁶⁰, the satellite-based maritime surveillance market is currently worth approx. USD1.7bn and forecast to grow to USD2.2bn by 2024 (source: HawkEye from Frost & Sullivan).

TRADITIONAL MARKET PLAYERS: COMPETITORS...OR PARTNERS?

Large specialised as well as diversified industrial companies control the world space and surveillance market The space market has been traditionally dominated by large industrial companies that have been present in this market for decades focusing on continuously expanding their presence. These companies have built up strong business relationships with relevant defence institutions and private companies worldwide, thereby securing large orders (e.g. from US government institutions). Top companies like Thales Alenia Space, Airbus Defence & Space, and OHB System in Europe, and Lockheed-Martin, Boeing, and Maxar Technologies (Space Systems Loral-SSL) in the United States, dominate the global market for large spacecraft and satellites (source: The Metamorphosis of the World Space Economy, 2016). Further significant players, which also have a dominant role in the maritime surveillance and information industries, are shown in table 7 below:

Table 7: Main players by market segment

Intelligence, surveillance and reconnaissance	Earth observation	Maritime security	Maritime Information
L3 Technologies Inc.	Airbus	AgustaWestland	Inmarsat
General Dynamics Corporation	iSi	FLIR Systems	L3 Technologies
Boeing	Maxar Technologies	Lockheed Martin	ORBCOMM
Elbit Systems Ltd	Thales Group	Northrop Grumman	Raytheon Company
BAE Systems plc	UrtheCast	Thales Group	Thales Group
Harris Corporation		BAE Systems	Garmin International
Thales-Raytheon Systems		General Dynamics	Intelsat S.A

Source: Mordor Intelligence, Technavio, Reportsmonitor, Research & Markets

“Old space” players, partners more than competitors None of the traditional “old space” observation players offers RF intelligence data. Furthermore, the traditional “old space” companies have a hard time competing with the lower cost structures and the technology advantage displayed by the “new space” insurgents. As a result, many of the traditional space players have shown interest in cooperating or buying RF data from the newcomers to integrate it into their portfolio. We therefore see “old space” players more as potential partners than competitors to Kleos.

In the next decade, Kleos can potentially become an acquisition target We also believe in the next decade once the new RF technology has shown its strength, M&A activity (ranging from minority participations up to full acquisitions) can become a relevant force in shaping the industry. Several “new space” segments are already showing first signs of M&A activity. We summarise a few examples overleaf:



- Lockheed Martin conducted a venture investment in the nanosatellite manufacturer Terrain Orbital/Tyvak.
- Boeing/Boeing Horizon X Ventures invested in the Australian nanosatellite communications start-up Myriota
- Airbus/Airbus Ventures invested in the Swiss nanosatellite start-up Astrocast
- Raytheon has secured privileged access to satellite-based RF intelligence data through a cooperation agreement accompanied by an investment in the US company HawkEye³⁶⁰, which is Kleos' only direct competitor.

OVERVIEW OF HAWKEYE³⁶⁰, KLEOS' ONLY DIRECT COMPETITOR

HawkEye³⁶⁰, strong US competitor with sound financing track record (USD30m) and order backlog (USD100m) At present, Kleos has only one direct competitor, which is HawkEye³⁶⁰. Founded in October 2015 in the US, HawkEye³⁶⁰ defines itself as a “data analytics company seeking to commercialise the capability to detect, independently geo-locate and analyse diverse RF signals from space”. The company has developed proprietary algorithms, which it aims to apply to RF signals detection and other forms of geospatial information to produce contextually relevant analytics and reports for government and private companies. The company's main focus is the maritime industry. HawkEye was founded by Allied Minds plc, a Venture Capital Fund and Incubator based in the US and listed in the UK. HawkEye managed to raise funds totalling about USD30m. The latest Series A3 round closed in September 2018, amounted to USD14.9m, and was led by the strategic investor Raytheon (large US government defence contractor). This round was conducted at a pre-money valuation of USD75m and also included the participation of Sumitomo Corporation, Razor's Edge Ventures, Shield Capital Partners, Space Angels, and Allied Minds (source: Allied Minds). In its short history of over three years HawkEye managed to attract defence, intelligence and commercial customers securing an order backlog of over USD100m.

First scouting CubeSats constellation launched in Dec/18 In December 2018, the company launched its first scouting cluster of three satellites on the SpaceX rideshare mission. After two months required for positioning and calibration of the satellites, in February 2019 the company started tracking RF signals and providing commercial service data to its customers. The company's strategy is currently primarily focused on highly lucrative US government contracts, which is reflected in a 16 member Advisory Board which includes several former high ranking US army officers, intelligence operatives (e.g. CIA) and government members.

Competitive position Overall, we believe HawkEye³⁶⁰ has a lead of about 6 months on the highly lucrative US market with respect to the timepoint of scouting satellites' launch and initial provision of RF data, and about 15-18 months related to the timepoint at which own AI-powered RF data analytics are provided. HawkEye's stronger standing with investors (USD30m raised so far), broader Advisory Board/Management/Marketing/R&D staff, and generally stronger organisation has enabled it to generate an order backlog of USD100m. Nevertheless, the US defence market is still large enough for two players. Kleos should still be able to capture a significant stake of the market. In addition, we believe Kleos is on track to be first to market in Europe and Australia. We also believe that RF technology will require a few years to demonstrate its full capabilities. As a result, we believe large customers may initially be likely to buy RF data from both players in order to compare data performance and accuracy. We show a comparison of some key items and metrics of Kleos with HawkEye³⁶⁰ in the table overleaf.

**Table 8: Comparison between Kleos and HawkEye³⁶⁰**

KEY ITEMS & METRICS	KLEOS	HAWKEYE ³⁶⁰
Founded	2017	2015
Funds raised so far	About €6.2m	About USD 30m
Strategic investors	-	Raytheon (Lead investor, last round USD14.9m)
Advisory Board strength	2 high profile members, one each for US/UK defence	16 high profile members focused on US defence
Company purpose	Offer satellite-based raw RF data & analytics	Offer intelligence based on satellite RF data
Industry focus	ISR – maritime	ISR – maritime
Regional focus	Europe, Australia, USA	USA
Satellite formation number	4 CubeSats per cluster	3 CubeSats per cluster
Total number of satellites	Up to 20 clusters and 80 satellites	Up to 10 clusters and 30 satellites
Scouting satellites launch status	First cluster launch planned for approx. June/19, first revenues expected in Q3/19	First cluster launched in Dec/18, satellites positioned & generating revenues since Feb/19
AI-powered data analytics	In preparation, first analytic product expected approx. 1 year after cluster launch (Mid 2020)	Largely completed, first own analytics products already generating revenues
Order backlog	Up to €3m	More than USD 100m
Number of employees	14	31

Source: First Berlin Equity Research, Kleos Space S.A., HawkEye³⁶⁰, Allied Minds.

Comparison of technology sensing capabilities There is little public information about the performance of Kleos' and HawkEye's proprietary technology using geolocating algorithms. Both companies claim the ability to be able to accurately geolocate targets within the maritime industry, suggesting similar levels of accuracy. A relevant difference is the size of the satellite constellations, which comprise either 3 in HawkEye's or 4 in Kleos' case. A research paper on geolocation of nanosatellite constellations published by the Air Force Institute of Technology in the US using simulation models concluded that 4-satellite formations outperform a 3-satellite formations. This suggests that Kleos could potentially deliver a better accuracy, but it would be speculative to determine if and how substantial this could be. We believe that the performance superiority can potentially become a key advantage for Kleos in the aeronautic application, which requires a third dimension (height) and is more complex. Nevertheless, unless the 4-satellite formation translates into a superior accuracy and value to the clients, it could turn into a competitive disadvantage due to higher CAPEX.



FINANCIAL HISTORY AND OUTLOOK

FINANCIAL HISTORY

In March 2018, Kleos Space S.A. published its FY/18 financial report in accordance with IFRS standards. The company achieved several relevant milestones in 2017 and 2018 which strongly impacted the FY/17 and FY/18 group figures and the 2019 financial outlook. The main highlights were:

- I) Founding of the company in August 2017,
- II) Approval of €2.0m grants for Kleos' space technology development programme by Luxemburg's Government in November 2017,
- III) Capital increase and listing on the Australian Stock Exchange in August 2018, secondary listing on the Frankfurt Stock Exchange in December 2018.

Income Statement FY 2018 Kleos' financial statement is typical of an early stage technology company. The company generates no revenues and is loss making. Kleos benefited from government grants from the Luxemburg government amounting to €828k in FY/18 (FY/17: €249k).

Operating expenses increased significantly to €1.2m in FY/18 (FY/17: €0.1m). This is predominantly due to two reasons. Firstly, higher legal, consulting and travel expenses for preparation and execution of the capital increase and stock exchange listing. Secondly, FY/18 was Kleos' first complete year of operation. Staff expenses also grew substantially to €1.7m (FY/17: €0.2m), which reflects an increase in headcount from six in FY/17 to nine employees in FY/18, as well as the full year effect.

The company's EBIT came in at €-2.2m in FY/18 (FY/17: €-0.2m). Kleos reported a net loss of €2.2m (FY/17: €0.2m), which equates to €-0.03 per share (FY/17: €-0.01).

Table 9: Income Statement 2018 and 2017 (selected items)

All figures in EUR '000	2018	2017	Delta
Revenue	0	0	n.a.
Government grants	828	249	232%
Operating expenses	1,210	79	1,439%
Staff expenses	1,680	203	728%
EBIT	-2,193	-183	n.a.
Net income / loss	-2,202	-183	n.a.
EPS	-0.03	-0.01	n.a.

Source: Kleos Space S.A

Balance Sheet FY 2018 At the end of FY/18, Kleos' equity position increased to €5.8m from €-0.2m at the end of FY/17. The company's equity position was substantially strengthened, corresponding to an equity ratio (ER) of 80.0% (FY/17 ER: -30.4%). This was the result of the two capital increases conducted in FY/18 raising a total of approx. €8.4m and the number of shares outstanding from 23.5m at the end of FY/17 to 106.6m at the end of FY/18. The company's cash position also rose to €4.3m (FY/17: €0.5m). Property plant and equipment increased from €0 to €1.9m as a result of the activation from progress achieved on the construction of the scouting satellite constellation ordered from GomSpace. As is typical of a young technology company, Kleos had no debt.

**Table 10: Balance Sheet 2018 and 2017 (selected items)**

All figures in EUR '000	2018	2017	Delta
Liquid funds	4,264	457	834%
Property, plant & equipment	1,918	0	n.a.
Total assets	7,245	481	1,406%
Equity	5,762	-171	n.a.
Equity ratio	80%	-36%	-

Source: Kleos Space S.A.

Cash Flow FY 2018 In FY/18, cash flow from operating activities came in at €-2.9m (FY/17: €0.3m) and cash flow from investing activities increased to €-1.3m (FY/17: €0.0m) due mainly to the payment for the satellite constellation. Cash flow from financing activities amounted to €7.9m (FY/17: €0.2m) with the increase being due to the two capital measures. Net cash flow thus came in at €3.8m (FY/17: €0.5m).

Table 11: Cash flow statement 2018 and 2017 (selected items)

All figures in EUR '000	2018	2017	Delta
Operating cash flow	-2,854	256	n.a.
Cash flow from investing	-1,257	0	n.a.
Cash flow from financing	7,918	201	3,849%
Net cash flow	3,807	457	n.a.

Source: Kleos Space S.A.

Q1/19 financial results On 29 April, Kleos published Q1/19 cash flow results. Cash flow from operating activities amounted to €-957k, including grant payments of €392k. Cash flow from investing activities came in at €-492k due mainly to investment in the satellite constellation. Cash flow from financing was €0. Net cash flow thus amounted to €-1.4k. The company reported a cash position of €2.8m (down from €4.3m at the end of FY/18).

FINANCIAL OUTLOOK

Sales Considering that Kleos is launching completely new products, it is difficult to predict the conditions and prices that the company will be able to negotiate with its clients. We therefore refer to deals closed by peers. Our estimates are conservative and well below typical contracts being closed in the industry (see chapter: On track to generate revenues). Following the anticipated satellite launch in June/19E, we project that first sales will be booked in H2/19E. We believe Kleos will mostly sell raw RF data at the beginning, with higher value added products including visualisation and AI-powered analytics progressively gaining momentum over the next few years. In addition, we have assumed that the company will launch about two satellite systems per year leading to a continuous increase of data refresh rates. These two factors will in our view make the products more attractive to a wider pool of clients, thus leading to rising numbers of interested clients, closed contracts, and sales. We have modelled that the average price per contract will increase from €350k in 2019E to €600k in 2022E. We project that Kleos will be able to grow sales from €1.1m in 2019E to €21.6m in 2022E. We give an overview of our sales model in table 12.

Table 12: Calculation of Revenue forecasts

Projections	2019E	2020E	2021E	2022E
Operational satellite constellations	1	3	5	7
Average price per contract T€	350	400	500	600
Number of clients	3	16	25	36
Revenue T€	1,050	6,400	12,500	21,600
Y-o-Y		510%	95%	73%

Source: First Berlin Equity Research estimates



Income Statement We project that the company will receive grants which will decline from €1m in 2018E to €100k in 2022E. Furthermore, as a DaaS company, Kleos COGS position will reflect the rent cost for the ground station as well as for the cloud service to manage and process the data on the Guardian ABI platform. We estimate that this cost will represent at the beginning about €300k p.a. (€150k in 2019E as it represents only a half year of operation) and will increase to €401k in 2022E.

Considering the company's expansion process is driven by satellite launches, we expect staff and depreciation expenses to increase significantly over the period 2019-2022. We project that staff expenses will grow from €2.5m in 2019E (2018: €1.7m) to €9.5m in 2022E. We also anticipate that depreciation expenses rise from €421k in 2019E (2018: €6k) to €4.4m in 2022E, which reflects our projected addition of 2 satellites constellations p.a. We assumed constellation cost of €2.9m with an operational life of about 4 years. In addition, we expect that operating expenses will decline to €578k (2018: €12m) in 2019E before showing a continued growth over the following years to €1.3m in 2022E. We note that operating expenses in 2018 included one-off expenses related to the IPO. We also modelled Kleos' royalty on profit obligation for the IP of 5% (2018-2020) and 2.5% (2021-2030) as part of other operating expenses. We estimate payments of €27k in 2021E and €144k in 2022E.

We anticipate that Kleos will achieve EBITDA break-even in 2020E and EBIT break-even in 2021E. We project that EBIT will improve from €-2.2m in 2018 to €-1.9m in 2019E and €-0.9 in 2020E. We anticipate that Kleos will reach EBIT profitability of €1.1m (EBIT margin: 8.5%) in 2021E, growing to €5.6m (EBIT margin: 26.1%) in 2022E.

We forecast no financial debt on Kleos' balance sheet in our forecasts and assume a 26% effective tax rate once the company reaches profitability. Due to Kleos' improving operating performance, we project the net result to improve significantly in the period 2019E-2022E. We forecast a net result of €-1.9m (EPS: €-0.02) in 2019E and a net profit of €4.2m (EPS: €0.02) in 2022E (see table 13).

Table 13: Revenue, EBITDA, EBIT, net income forecasts (selected items)

All figures in EUR '000	2017	2018	2019E	2020E	2021E	2022E
Revenues	0	0	1,050	6,400	12,500	21,600
Government grants	249	828	1,000	800	100	100
Total revenue and grants	249	828	2,050	7,200	12,600	21,700
COGS	0	0	-150	-300	-348	-401
Gross profit	249	828	1,900	6,900	12,252	21,299
Operating expenses	-79	-1,210	-578	-640	-896	-1,254
Staff expenses	-203	-1,680	-2,520	-5,120	-6,963	-9,470
R&D and others	-151	-125	-305	-378	-432	-589
EBITDA	-183	-2,187	-1,502	762	3,961	9,985
Depreciation	0	-6	-421	-1,631	-2,900	-4,350
Operating income (EBIT)	-183	-2,193	-1,923	-869	1,061	5,635
Net income / loss	-183	-2,202	-1,923	-862	788	4,172
Margins in % from total revenue and grants						
Gross profit	n.a.	100.0%	92.7%	95.8%	97.2%	98.2%
EBITDA	n.a.	n.a.	n.a.	10.6%	31.4%	46.0%
Operating income (EBIT)	n.a.	n.a.	n.a.	n.a.	8.5%	26.1%
Y-Y Growth						
Revenues	n.a.	n.a.	n.a.	509.5%	95.3%	72.8%
EBITDA	n.a.	n.a.	n.a.	n.a.	419.8%	152.1%
Operating income (EBIT)	n.a.	n.a.	n.a.	n.a.	n.a.	431.0%

Source: First Berlin Equity Research, Kleos Space S.A.



Our 2019E-2022E estimates were the baseline for our projections through 2030E. We have taken typical industry technology cycles into consideration. In our model, the company will have 10 operational satellite constellations by 2025E, which will be maintained through 2030E.

Balance Sheet We estimate the company will increase its receivables in 2019E to €158k (2018: €0), which we forecast to expand further to €3.3m in 2022E. Due to the addition of about two satellite constellations per year, we anticipate that property plant and equipment will grow to €4.4m in 2019E (2018: €1.9m), rising to €129m in 2022E. We look for Kleos to raise capital of €5.0m in 2019E and a further €5.0m in 2020E. We expect the €10m to adequately fund operations over the next three years until the business model of the company becomes self-sustaining by 2022E. At that point, the company will be generating enough cash to finance further organic growth. This will be reflected in a progressively growing cash position from 2022E (see table 14).

Table 14: Balance sheet KPIs 2017-2022E

All figures in EUR '000	2017	2018	2019E	2020E	2021E	2022E
Cash and cash equivalents	457	4,264	4,009	3,368	448	1,866
Receivables	0	0	158	964	1,884	3,255
Current assets, total	481	5,327	5,306	5,386	3,371	6,192
Property, plant & equipment	0	1,918	4,397	8,566	11,466	12,916
Non-current assets, total	0	1,918	4,397	8,566	11,466	12,916
Shareholders' equity	-171	5,762	8,839	12,977	13,765	17,937
Equity ratio	-36%	80%	91%	93%	93%	94%
Balance sheet, total	481	7,245	9,704	13,952	14,837	19,108

Source: First Berlin Equity Research, Kleos Space S.A.

Cash Flow Statement On our numbers, Kleos will generate negative free cash flow (FCFF) of €-5.3m in 2019E, we and anticipate initial positive operating cash flow of €0.2m in 2020E. Due to CAPEX of €5.8m for two satellite constellations, we still forecast a negative free cash flow of €-5.6m in 2020E. This figure should improve substantially to €-2.9m in 2021E and turn positive in 2022E at €1.4m. Going forward we estimate that the positive trend of strengthening operating performance and cash flow will continue having a positive impact on the company's free cash flow and net cash flow (see table 15).

Table 15: Cash Flow Statement (selected items) 2017 – 2022E

All figures in EUR '000	2017	2018	2019E	2020E	2021E	2022E
Operating cash flow	256	-2,854	-2,355	159	2,880	7,218
CapEx	0	-1,257	-2,900	-5,800	-5,800	-5,800
Free cash flow	256	-4,111	-5,255	-5,641	-2,920	1,418
Cash flow from financing	201	7,918	5,000	5,000	0	0
Net cash flow	457	3,807	-255	-640	-2,920	1,418

Source: First Berlin Equity Research, Kleos Space S.A.



NEWSFLOW

In our view, Kleos' stock price will be driven by news about its business as well as achievement of financial milestones. We expect the company to make a number of announcements during the coming 12-18 months which will act as catalysts for the stock. These include:

Business

- Launch of the scouting satellite system due by approx. June 2019,
- Announcements on distribution agreements,
- Announcements on sales contracts,
- Launch of further satellite systems in 2020.

Financial Schedule

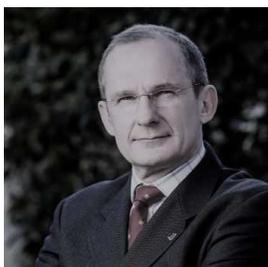
- Q2/19 cash flow results due at the end of July 2019,
- Q3/19 cash flow results due at the end of October 2019,
- Q4/19 cash flow results due at the end of January 2020.

MANAGEMENT

Kleos' board currently comprises three executive directors and one non-executive director. The board has a broad range of experience in the development and commercialisation of space technology, and more broadly, in the Government and Non-Government defence and security sectors.

BOARD OF DIRECTORS

Air Commodore Peter Round, Chairman/Executive Director



Mr. Round is an expert in EU Defence issues, military affairs and has led multiple multi-million Euro contracts within the Defence industry. He is an internationally renowned strategic executive with experience in the US, EU and NATO. With over 30 years' experience as a military pilot, he has flown buccaneers in the maritime strike/attack role and spent time as Qualified Flying Instructor. He ran UK Basic Fast Jet Pilot Training and later, initial flight training for all Royal Navy, British Army and RAF aircrew. Mr. Round also previously served as a US Air Force Instructor Pilot.

From 2007 Mr. Round spent three years as the UK National Liaison Representative to NATO Supreme Allied Commander Transformation. Following a period as a Group Senior Operator with responsibility for 200 aircraft of 16 types, including the Red Arrows Aerobatic Display Team, he was appointed Capability, Armament and Technology Director at the European Defence Agency. He left this fixed term appointment after five years in 2017. In between, Mr Round completed operational tours as the RAF Detachment Commander at Prince Sultan Air Force Base, Saudi Arabia and as an Operations Team Leader at the UK Permanent Joint Headquarters, with responsibility for UK and multinational operations in Afghanistan, the Balkans and all United Kingdom-supported United Nations operations. He also completed three tours in the UK Ministry of Defence.

Mr. Round joined Kleos' management board on 5 April 2018 as chairman and executive director, working as an advisor to the Board on corporate strategy and relationship building. His role is integral to engagement with external stakeholders, acting as a military liaison and point of contact for government representatives as well as other organisations within the market. Mr. Round holds an Honours Degree in Metallurgy from Manchester University and a Masters Degree in Defence Studies from Kings College, London.

Andrew Bowyer, CEO



Mr. Bowyer has over 15 years experience in the space industry. He held leadership positions in space technology development firms with a successful track record in the execution of space projects including missions to Mars and Mercury and 'spinning-out' technology into other industries. Mr Bowyer co-founded and has served as CEO the space technology engineering firm Magna Parva since 2005. At Magna Parva, he was responsible for implementing long term innovation and business development strategy, financials as well as deal closings. Under his leadership, Magna Parva successfully carried out numerous development and delivery of space hardware, working with some of the world's leading organisations such as European Space Agency (ESA), Luxembourg Government, UK Space Agency, UK Ministry of Defence, BAE, Airbus Defence & Space,



Thales, as well as leading Universities. In 2017, Mr. Bowyer co-founded Kleos Space, leading the company's strategy and execution since inception. He was acknowledged by Codex as one of the world's top 50 innovators from industries of the future in 2017. Mr. Bowyer holds a Bachelor of Science from Leeds Beckett University in the UK.

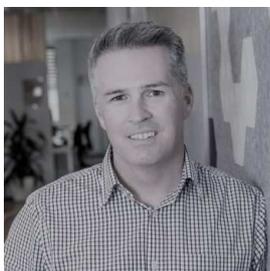
Miles Ashcroft – CTO



Mr. Ashcroft has more than 25 years' experience in engineering, delivering technically ground breaking and high value space engineering hardware to multiple international space agencies. He spent over 10 years in management and technical leadership positions at R&D startup companies and automotive, motorsport (F1), aerospace and space companies. Mr. Ashcroft co-founded and has served as CTO of the space engineering company Magna Parva since 2005, where he was responsible of delivering high value and technically complex space projects.

Mr. Ashcroft also co-founded Kleos Space as a spin-off from Magna Parva in 2017. He has been the CTO since inception and leads the company's technology strategy. Mr. Ashcroft is qualified with a Bachelor of Aeronautical Engineering (Honours) from Salford University and is a CEng (Chartered Engineer), MRAeS (Member of the Royal Aeronautical Society), FRAS (Fellow of the Royal Astronomical Society). He is also the inventor or co-inventor on eight granted patents.

David Christie – Independent Non-Executive Director



Mr. Christie has over 20 years' experience as senior legal executive with global responsibility for legal affairs, ASX governance, litigation and intellectual property matters, Chief Strategy Officer, General Counsel and Company Secretary with iSelect (ASX: ISU). At the beginning of his career, he held several legal positions with law firms such as Minter Ellison Lawyers (Sydney), Simmons & Simmons Lawyers (London), before joining Deutsche Bank AG (UK) as Senior Lawyer. After that, he was director of multiple international companies until he became the

Global Head of Legal for Renaissance Capital Limited (London). In 2013, he joined the ASX listed iSelect Ltd (ASX: ISU) as Chief Strategy Officer, General Counsel and Company Secretary.

Mr. Christie holds a BA / LLB Law from the University of Canberra, LLM in International Law from the University of Edinburgh, Scotland, and is a graduate of the Australian Institute of Company Directors.



SUPERVISORY BOARD

Kleos' advisory board initially comprises two leading geospatial intelligence and defence advisers from the United States and UK. They are both international opinion leaders in their respective specialty areas across security, counter-intelligence, geospatial intelligence, government and defence projects. We believe the company will further expand the board over the next couple of years.

Karyn Hayes-Ryan – US Strategy Advisor

Ms. Hayes-Ryan is a former intelligence community and Department of Defence senior executive with an extensive history in defence, aerospace and IT. Having held senior executive roles in the National Geospatial Intelligence Agency and National Reconnaissance Office, she brings extensive experience and skill sets in government acquisition, program management, agile acquisition, engineering, integration, data analytics, technology management, source selection, Federal Acquisition Regulation and procurement to the advisory board.

Roger Davies MBE QGM – Defence & Security Advisor

Mr. Davies is a former officer of the British Army with specialties in bomb disposal, counter terrorism, intelligence and special projects. Mr Davies was founder and CEO of HMS Ltd (Counter IED Services) and VP business development for Allen Vanguard (Electronic Warfare Technologies). Before retiring he was the founder of Intelligence Management Support Services Ltd, a provider of intelligence consultancy, data and analysis services to governments and industry.



SHAREHOLDERS & STOCK INFORMATION

Stock Information	
ISIN	AU0000015588
WKN	A2N4R3
Bloomberg ticker	KS1:GR & KSS:AU
No. of issued shares	106,627,500
Transparency Standard	Open Market
Country	Germany / Australia
Sector	Software and services
Industry	Aerospace

Source: Börse Frankfurt, ASX, First Berlin Equity Research

Shareholder Structure	
Magna Parva Ltd.	23.45%
LTL Capital Pty Ltd.	13.94%
Tyler Corporation Pty Ltd.	3.25%
Bradley Saxby	3.25%
Bianca Silver	3.03%
Bainpro Nominees Pty Ltd.	2.57%
Sterling Venture Holdings Pty Ltd.	2.53%
Jindabyne Capital Pty Ltd.	2.39%
Others	45.59%
Total	100.0%

Source: Kleos Space S.A. (as of 30 April 2019)



INCOME STATEMENT

All figures in EUR '000	2017	2018	2019E	2020E	2021E	2022E
Revenues	0	0	1,050	6,400	12,500	21,600
Government grants	249	828	1,000	800	100	100
Total revenue and grants	249	828	2,050	7,200	12,600	21,700
Cost of goods sold	0	0	-150	-300	-348	-401
Gross profit	249	828	1,900	6,900	12,252	21,299
Operating expenses	-79	-1,210	-578	-640	-896	-1,254
Staff expenses	-203	-1,680	-2,520	-5,120	-6,963	-9,470
Research & development	-149	-114	-105	-128	-134	-148
Other operating expenses	-2	-11	-200	-250	-297	-441
EBITDA	-183	-2,187	-1,502	762	3,961	9,985
Depreciation expenses	0	-6	-421	-1,631	-2,900	-4,350
Operating income (EBIT)	-183	-2,193	-1,923	-869	1,061	5,635
Net financial result	0	-9	0	7	4	2
Pre-tax income (EBT)	-183	-2,202	-1,923	-862	1,065	5,637
Tax result	0	0	0	0	-277	-1,466
Net income / loss	-183	-2,202	-1,923	-862	788	4,172
Other comprehensive income (currency related)	0	1	0	0	0	0
Total comprehensive income	-183	-2,201	-1,923	-862	788	4,172
Diluted EPS (in €)	-0.01	-0.03	-0.02	0.00	0.00	0.02

Ratios as % of total revenue and grants

Gross margin	n.a.	100.0%	92.7%	95.8%	97.2%	98.2%
EBITDA margin	n.a.	n.a.	n.a.	10.6%	31.4%	46.0%
EBIT margin	n.a.	n.a.	n.a.	n.a.	8.4%	26.0%
Net margin	n.a.	n.a.	n.a.	n.a.	6.3%	19.2%
Tax rate	0.0%	3.0%	26.0%	26.0%	26.0%	26.0%

Expenses as % of total revenue and grants

Operating expenses	n.a.	n.a.	28.2%	8.9%	7.1%	5.8%
Staff expenses	n.a.	n.a.	122.9%	71.1%	55.3%	43.6%
Research & development	n.a.	n.a.	5.1%	1.8%	1.1%	0.7%
Depreciation expenses	n.a.	n.a.	20.5%	22.7%	23.0%	20.0%

Y-Y Growth

Revenues	n.a.	n.a.	n.a.	509.5%	95.3%	72.8%
Government grants	n.a.	232.2%	20.8%	-20.0%	-87.5%	0.0%
Operating expenses	n.a.	1438.8%	-52.3%	10.8%	40.0%	40.0%
Staff expenses	n.a.	728.2%	50.0%	103.2%	36.0%	36.0%
EBITDA	n.a.	n.a.	n.a.	n.a.	419.8%	152.1%
Operating income (EBIT)	n.a.	n.a.	n.a.	n.a.	n.a.	431.0%
Net income/ loss	n.a.	n.a.	n.a.	n.a.	n.a.	429.2%



BALANCE SHEET

All figures in EUR '000	2017	2018	2019E	2020E	2021E	2022E
Assets						
Current assets, total	481	5,327	5,306	5,386	3,371	6,192
Cash and cash equivalents	457	4,264	4,009	3,368	448	1,866
Receivables	0	0	158	964	1,884	3,255
Accrued income (gov. grants)	0	392	400	240	144	86
Other current assets	25	672	739	813	895	984
Non-current assets, total	0	1,918	4,397	8,566	11,466	12,916
Property, plant & equipment	0	1,918	4,397	8,566	11,466	12,916
Total assets	481	7,245	9,704	13,952	14,837	19,108
Shareholders' equity & debt						
Current liabilities, total	652	1,484	865	975	1,071	1,171
Short-term debt	0	0	0	0	0	0
Accounts payable	21	729	35	62	67	66
Accruals	7	754	830	913	1,004	1,104
Other current liabilities	625	1	1	1	1	1
Long-term liabilities, total	0	0	0	0	0	0
Long-term debt	0	0	0	0	0	0
Shareholders' equity	-171	5,762	8,839	12,977	13,765	17,937
Total consolidated equity and debt	481	7,245	9,704	13,952	14,837	19,108
Ratios						
Current ratio (x)	0.7	3.6	6.1	5.5	3.1	5.3
Quick ratio (x)	0.7	3.6	6.1	5.5	3.1	5.3
Net debt/(net cash)	-457	-4,264	-4,009	-3,368	-448	-1,866
Net gearing	267.0%	-74.0%	-45.4%	-26.0%	-3.3%	-10.4%
Book value per share (in €)	-0.01	0.09	0.08	0.07	0.06	0.08
Return on equity (ROE)	107.3%	-38.2%	-21.8%	-6.6%	5.7%	23.3%
Equity ratio	n.a.	79.5%	91.1%	93.0%	92.8%	93.9%



CASH FLOW STATEMENT

All figures in EUR '000	2017	2018	2019E	2020E	2021E	2022E
Net income	-183	-2,202	-1,923	-862	788	4,172
Depreciation and amortisation	0	6	421	1,631	2,900	4,350
Tax expense	0	0	0	0	0	0
Changes in working capital	-147	-208	-853	-610	-808	-1,304
Other adjustments	586	-451	0	0	0	0
Operating cash flow	256	-2,854	-2,355	159	2,880	7,218
Net operating cash flow	256	-2,854	-2,355	159	2,880	7,218
CapEx	0	-1,257	-2,900	-5,800	-5,800	-5,800
Free cash flow	256	-4,111	-5,255	-5,641	-2,920	1,418
Other investments and disposals	0	0	0	0	0	0
Cash flow from investing	0	-1,257	-2,900	-5,800	-5,800	-5,800
Debt financing, net	0	0	0	0	0	0
Equity financing, net	201	7,918	5,000	5,000	0	0
Cash flow from financing	201	7,918	5,000	5,000	0	0
Net cash flow	457	3,807	-255	-640	-2,920	1,418
Cash, start of the year	0	457	4,264	4,009	3,368	448
Cash, end of the year	457	4,264	4,009	3,368	448	1,866
EBITDA/share (in €)	-0.01	-0.03	-0.01	0.00	0.02	0.05
Y-Y Growth						
Operating cash flow	n.a.	n.a.	n.a.	n.a.	1707.7%	150.6%
Free cash flow	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
EBITDA/share	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

FIRST BERLIN RECOMMENDATION & PRICE TARGET HISTORY

Report No.:	Date of publication	Previous day closing price	Recommendation	Price target
Initial Report	2 May 2019	AUD 0.26		AUD0.43

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- key sources of information in the preparation of this research report
- valuation methods and principles
- sensitivity of valuation parameters

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SUPERVISORY AUTHORITY: Bundesanstalt für Finanzdienstleistungsaufsicht (German Federal Financial Supervisory Authority) [BaFin], Graurheindorferstraße 108, 53117 Bonn and Lurgiallee 12, 60439 Frankfurt

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