

New Space Economy Study

Workshop, 6 February 2019

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- Introduction to SpaceTec Partners
- NewSpace in Finland
- German Space Status Quo
- Opportunities for Finnish Companies
- Potential Entry Strategies

SpaceTec Partners serves clients in public and private sector

Public Sector

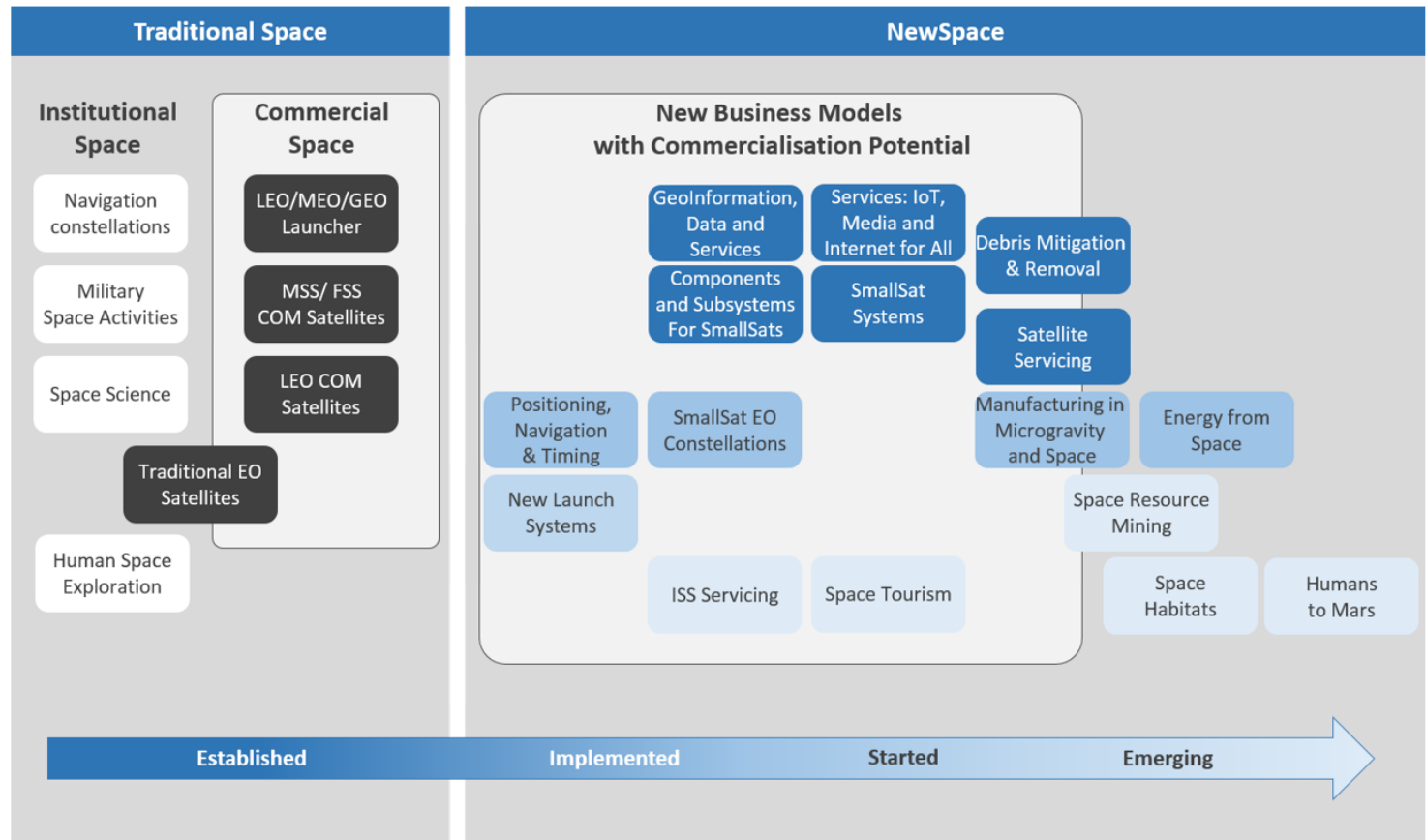


Private Sector





SpaceTec's study for the German Federal Ministry of Economy in 2016



Brand new study by SpaceTec Partners with the European Investment Bank

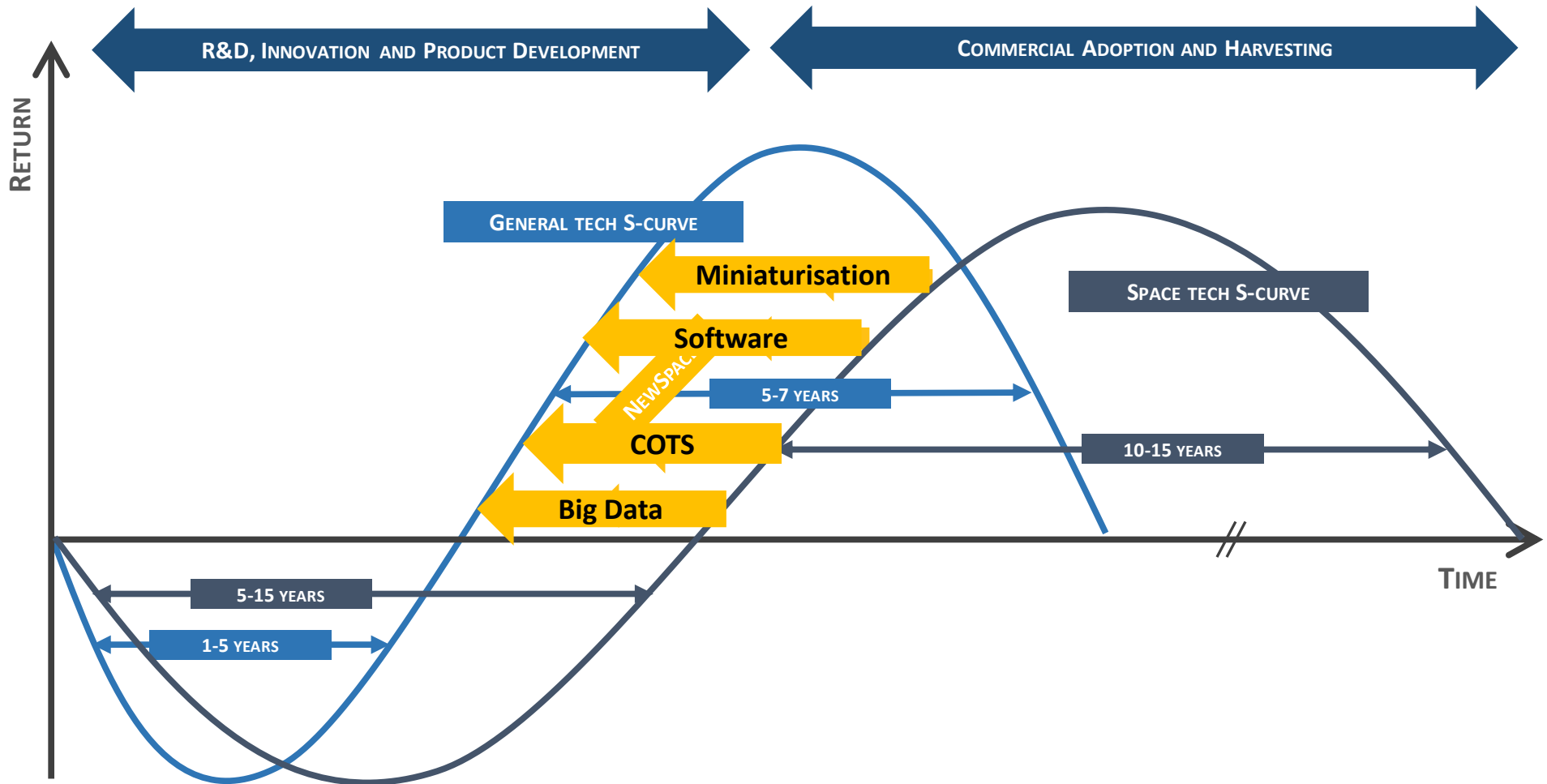


- Market data on space market and financing
- Innovations behind NewSpace
- Overview of space business models, risks and opportunities
- Comparisons with North America
- Overview of public and private funding
- Financing case studies on different start-ups
- Exits to date and their rationale
- Recommendations for to boost investment landscape



<http://www.eib.org/en/infocentre/publications/all/the-future-of-the-european-space-sector-report.htm>

NewSpace mindset makes Space Tech investable for Venture Capital



Source: SpaceTec Partners

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The NewSpace Economy taps into markets beyond traditional space

Context of the Study conducted by SpaceTec Partners for Business Finland

- The NewSpace economy fuels the industrial transformation of industries using space data and technologies
- Finland has embarked on a New Space Economy programme to help start-ups to renew the space sector and manufacturing companies to seek growth, as well as businesses that utilise data.
- Business Finland wants to optimally deploy its network and resources to the benefit of the domestic NewSpace players
- Germany with its strong and export oriented industrial base has been **chosen as a pilot** for a structured approach in five sectors/industry domain
 - Connectivity and IoT
 - Urban development
 - Bioeconomy
 - Security
 - Space technology
- Business Finland wanted to understand the **needs** of the German market, the **business opportunity** for Finnish companies and what **actions** can be taken in the German market

Business Finland has entrusted STP to perform the specified analyses



NewSpace in Finland can be categorised into five industry domains

Spa Space Technology

The development of space equipment and related systems – such as sensors, software, sub-systems, structures and components ... etc.

Bio Bioeconomy

Renewable biological resources from land and sea – such as natural resources & climate change monitoring, natural forest management, waste as a source of bioenergy, ... etc.

Urb Urban Development

Improvement and adaptation of infrastructure – relating to infrastructure development, urban planning & maintenance, population and refugee migration patterns,... etc.

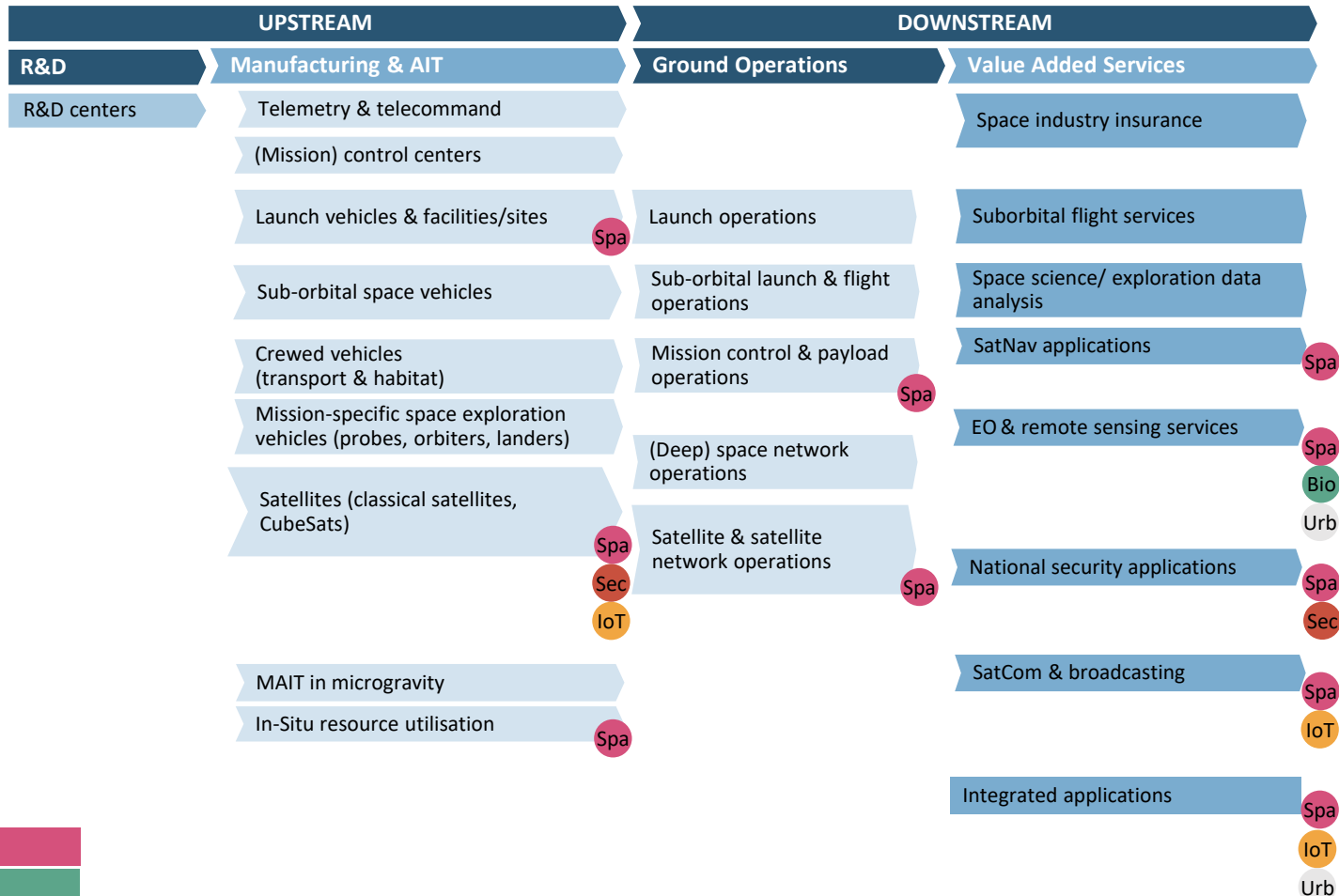
IoT Connectivity & IoT

Communication solutions, enablers and infrastructure – such as autonomous mobility, asset management, tracking & logistics, ... etc.

IoT Security

Protection of national resources and interests – such as safety and surveillance, monitoring of high value assets, maritime safety, coastline monitoring, ... etc.

Finnish NewSpace has been mapped against the space value chain



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While the traditional space business is well developed in Germany, the NewSpace economy is still emerging

Traditional space in Germany

- One of the largest contributors to the European Space Agency's budget with 23% of the total budget (ISS, Launchers, etc.)
- Strong manufacturing base, enabling the industry supply chain transformation process
- Leading players in all business segments, from equipment manufacturers, material and component suppliers to system integrators and service providers
- Airbus & OHB are the backbone of large-scale European space projects in traditional space

Emerging NewSpace Scene

- Several European innovation schemes have been initiated and are run from Germany (e.g. Master's Competitions)
- Home to some of the most successful ESA BICs (ESA BIC Bavaria has supported 96 start-ups)
- Many SMEs and VSMEs with export ambitions
- German space agency (DLR) focuses on driving networking and facilitation, e.g. DLR INNOSpace & Komponenteninitiative (SME export initiative)
- Recent NewSpace momentum driven by the new Federal Aerospace Coordinator and industry associations (BDI)

Drivers and targets

- Sustainable urban development
 - Economic land management
 - Sustainable urban mobility management
 - Socially responsible housing provision
 - Integrated urban development
- Demographic changes, urbanisation
- Energy-oriented modernisation
- Strengthened urban-rural cooperation
- Adapting regional planning to climate change
- Selected 'Smart Cities' developments – often around electric drive infrastructure

Status quo in Germany

- Federal Ministry of Transport and Digital Infrastructure (BMVI) is responsible for planning federal infrastructure (motorways, railways, shipping)
- 2030 Federal Transport Infrastructure Plan: 270 B€ dedicated for transport infrastructure by the Federal Ministry of Transport
- Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) oversees the development of cities and communities
- Germany's federal structure reflects in a **decentralised infrastructure management** model urban structure with federal, state, metropolitan regions, cities, municipalities medium-sized and small towns, each with their own jurisdiction
- Actual planning / geoinformation / mapping responsibility largely reside on state level with differing governance models

German strengths in logistics, mobility and communication technologies provide opportunities for Finnish companies

Connectivity & IoT

Autonomous mobility leaders	<ul style="list-style-type: none">▪ Strong automotive industry with leading car manufacturers (e.g. Daimler, BMW, VW Group) and automotive suppliers (e.g. Bosch, Continental)▪ Intelligent Transport Systems▪ Federal Ministry of Transport and Digital Infrastructure's 'Strategy for Automated and Connected Driving'
IoT hub	<ul style="list-style-type: none">▪ Siemens, Software AG, SAP and others investing heavily in IoT▪ Demand driven by Smart Automotive and Transport solutions
Industry 4.0	<ul style="list-style-type: none">▪ Strategic federal initiative to push forward digital transformation in advanced manufacturing▪ Technological leadership in industrial production R&D
Intelligent Logistics Systems	<ul style="list-style-type: none">▪ Logistics is the third largest sector of the German economy transporting over 4.3 billion tonnes of goods▪ Freight Transport and Logistics Action Plan puts forward goals and measures to support the freight transport and logistics industry in fulfilling its comprehensive tasks.▪ Logistics Alliance Germany consists of around 70 large, medium-sized and small companies
Satellite communication	<ul style="list-style-type: none">▪ Germany pursuing 5G SatCom ambitions, targeting a demo in an emerging 5G Industrial Makerspace▪ Satcom laser component champions (e.g. Mynaric, TESAT)▪ Cluster for Satellite Communication (DeSK) consists of 38 SMEs and research institutions, focused mainly on Baden-Wurttemberg▪ Current discussion on potential role of SatCom in 5G licensing process (whitespots)

- Internal security & Critical infrastructure protection:
 - Telecommunications networks
 - Railway lines and nodes
 - Airports
 - Power stations, Energy grid, pipelines (Nord Stream 2)
 - Wind farms
 - Key bridges, infrastructure computing centres and operations centres
- Smart borders - Migration mitigation infrastructure technology / need for cooperation on outer EU borders / FRONTEX
- ICT and Cybersecurity
 - Secure and private data communication
 - Electronic identity safety

Opportunities may lie in German agricultural & renewable energy industries

Agriculture

- 3rd largest importer and exporter of agricultural goods in the EU
- 4th largest agricultural producer in the EU
- Half of German land is farmed, of which
 - 90% managed by the owners themselves
 - 10% formed in partnerships, limited liability companies, cooperatives & private limited companies and cultivate over a third of Germany's farmland

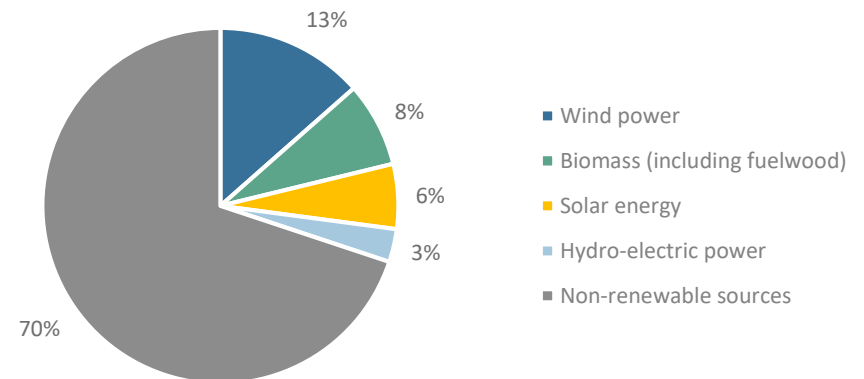


10-16 November
Hannover

Renewables

- Germany generates 30% of its energy need from renewables
- 18% of agricultural land is used for growing biofuels
- Germany saves around 7.3 million tonnes of emissions through the use of biofuels

Percentage of Total Energy made up by Renewable Energy Sources in Germany

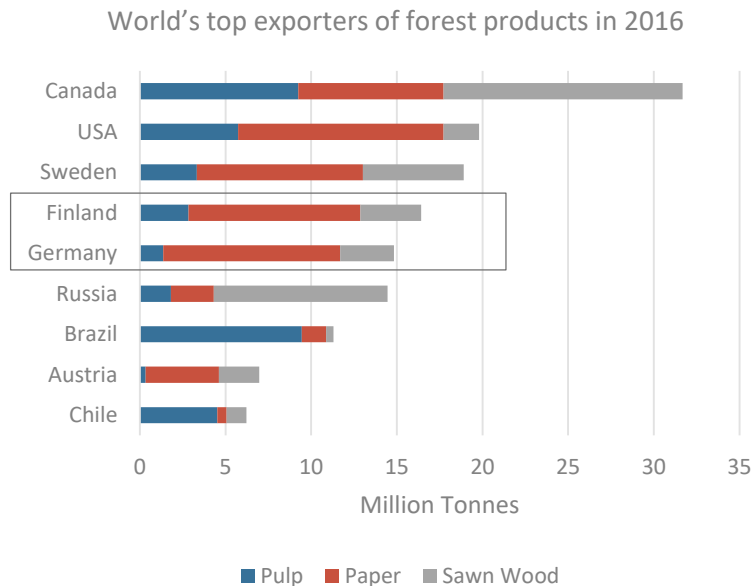


Source: Federal Ministry of Food and Agriculture, Agrarheute.com

Finnish forestry service providers would have to adjust to the forestry business environment in Germany

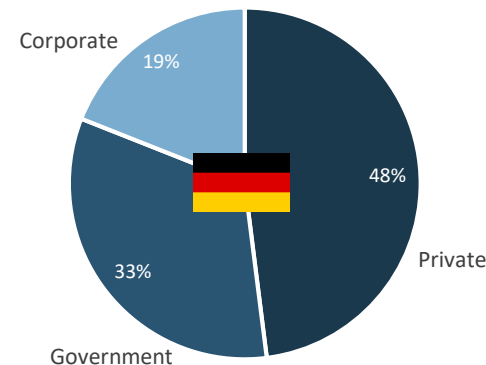
Bioeconomy

While Germany and Finland have a similar export-orientation and product-mix....



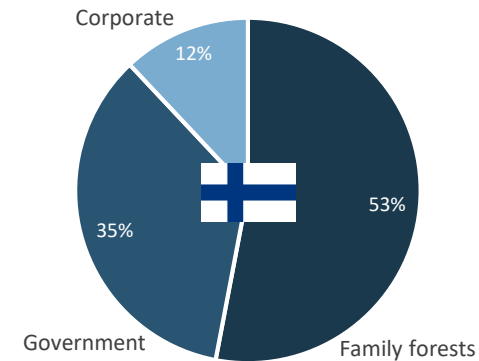
.... the ownership structure in Germany is very heterogeneous

The forests in Germany (approx. 11M ha) are distributed among approx. **2 million owners**



5,5 ha/owner

The forests in Finland (approx. 26M ha) are distributed among approx. **630,000 owners**



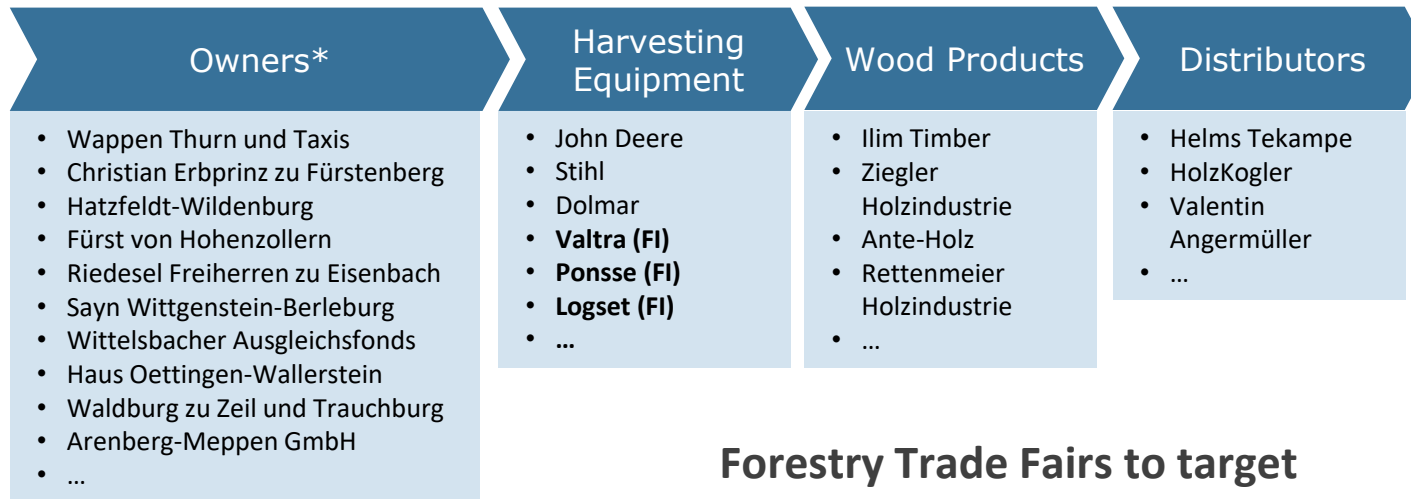
42 ha/owner

Source: EARSC, Bundeswaldinventur, Natural Resources Institute Finland

One path could be to explore cooperation with large private forest owners and/or export-oriented equipment producers

Bioeconomy

German Forestry Value Chain



*Top 10 in Germany

Forestry Trade Fairs to target

- IPM Germany, January 22-25, 2019 in Essen
- FORSTlive, March 29-31, 2019 in Offenburg
- Agra, April 25-28, 2019 in Leipzig
- Ligna, May 27-31, 2019 in Hannover
- Niederbayern Schau, October 2-6, 2019 in Landshut
- MeLa, September 2019 in Gülzow-Prüzen

Source: Wald-Prinz.de, Timber-Online.de

Non-space companies engaging in space tech



Partnership with ESA



Invested in 2 Space Tech Startups



*Partnership with ESA
Invested in two flat antenna startups*



Diversified from Defence into Space



*Exxfire fire suppression system complements
solutions for critical **infrastructure** offering*



Leading 3D-Printer Producer



EO Analytics Startup in Accelerator



Works with EDRS and Mynaric

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Challenges/Competition

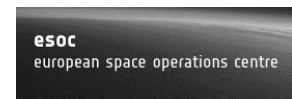
- DLR Space Agency predominantly supporting domestic industry
- SmallSat & leading component players (Berlin Space Technologies, German Orbital Systems, Astro- & Feinwerktechnik, TESAT etc.)

Opportunities for Finnish NewSpace players

- Home of two large scale integrators (LSIs): Airbus & OHB
- Explore SSA, GovSatCom cooperation
- Explore cooperation with pre-existing control centre capability in Germany: ESOC, GSOC, Galileo, Planet, IABG (Military), Space Situation Centre
- Tap 5G innovation cluster (Fraunhofer FOKUS Berlin)
- ESA contests, EU Horizon Prize for Launchers

Opportunities for Business Finland to support

- Engage through Nokia in DLR 5G activities
- SSA (Finnish solar storms competence)
- Seek dialogue with German Centre for SSA on ICAO cooperation in SSA
- Leverage DLR initiatives for non-space outreach (e.g. INNOspace & Komponenteninitiative)
- Network in German clusters (e.g. bavAIRia e.V)
- Consider Finland Partner Stand at SpaceTech Expo Europe in Bremen
- Show presence at InnoSpace events



Challenges/Competition

- Several GIS providers serving the domestic market (membership list Runder Tisch GIS e.V.)
- German market very regional
- German value-added service providers internationally very active (GAF, EOMAP, EFTAS)



Opportunities for Finnish NewSpace players

- Explore demand from insurance companies (e.g. MunichRe, Allianz, HannoverRe, etc.)
- Target infrastructure monitoring applications with large companies (e.g. E.ON, Innogy, Vattenfall, Deutsche Bahn, TenneT, etc.) to provide infrastructure security solutions
 - Deutsche Bahn (railway track security)
 - Deutsche Telekom (base stations)
 - NordStream 2 oil pipeline



Opportunities for Business Finland to support

- Showcasing Finnish Geospatial industry at **Intergeo Fair**
- Consider side event for matchmaking
- Showcase drone monitoring solutions made in Finland
- Link to German EO/Copernicus cluster activities driven by DLR/BMVI



Starting points for entry into Germany

Connectivity & IoT

Challenges/Competition

- Many corporates will have started discussions with some providers already
- German-origin players
 - IOT constellation for broadband: KLEO Connect
 - LCD – phased Array Antennas: Alcan, VITES (IABG)
- Germany terrestrial M2M players: e.g. Device Insight GmbH (Munich)

KLEO

systems
alcan
Communication is the key

VITES

DEVICE
INSIGHT

Opportunities for Finnish NewSpace players

- Collaborate with automotive OEMs and their supplier base (e.g. VW, BMW)
- Tap German machine building industry – servicing globally
- Export-oriented equipment industry looking for backbone with global service models
- Connect with German multinationals with 5G ambitions (e.g. Vodafone, Daimler, Siemens)
- Embrace SatCom laser component champions (Mynaric, TESAT)

mynaric

TESAT
SPACECOM

Opportunities for Business Finland to support

- Connect with German ambitions in 5G SatCom (Exhibit at DLR's National SatCom Exhibition in May 2019 – Possible theme: "Industrial Transformation with Finnish Technology")
- Tap German export champions at Hannover Messe

HANNOVER
MESSE

Challenges/Competition

- Existing but publicly not debated threats of cybersecurity and infrastructure threats
- Any current dependence on non-EU players?

Opportunities for Finnish NewSpace players

- Demand for cybersecurity, Germany making significant investments
- Critical asset monitoring solutions of growing importance
- Joint approach with EU defence contractors in EU Space & Defence ambitions (IABG)
- Connect with large infrastructure and energy players (e.g. BayWa, Aral, DEA, Wintershall)

Opportunities for Business Finland to support

- Intensify institutional connection between Competent PRS Authorities (Galileo Secure Service)
- Leverage Nokia trusted brand in this context for smaller players
- German shipping industry e.g. Meyer-Werft GmbH & Co KG (market leader cruise & LPG transport ships)



Starting points for entry into Germany

Bioeconomy

Challenges/Competition

- German forestry market differs significantly from Finland (ownership, type of forestry business etc.)

Opportunities for Finnish NewSpace players

- Liaise with insurance companies (e.g. MunichRe, Allianz, HannoverRe etc.)
- Partner with SAP as multiplier into global B2B markets
- Seek cooperation with Finnish wood-harvesting producers active in Germany (Ponsse, Valtra, etc.)
- Provide forestry solutions to infrastructure providers like Deutsche Bahn
- Target export markets with German actors, e.g. GAF AG, (sustainability markets, rainforest etc.)

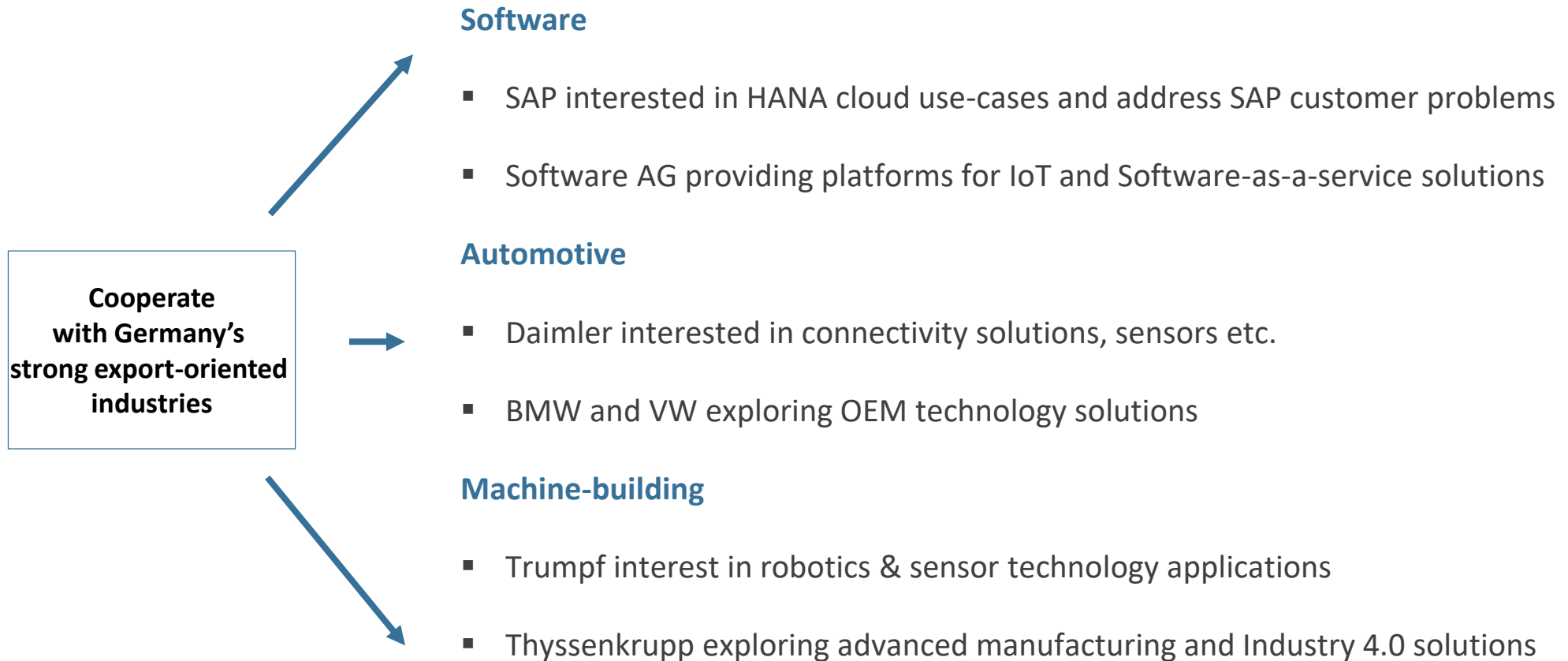
Opportunities for Business Finland to support

- Leverage 'Partner Country' status at Grüne Woche to engage the community
- Consider Finnish presence with a stand at Agritechnika 2019 (Hannover)



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Linking Finland NewSpace with German non-space corporates/multipliers



Linking with German partners with integrator capabilities

AIRBUS

- Manned and exploratory space systems
- Galileo IOV
- Key components for launchers and satellites
- Solar panels
- ...



- Galileo constellation
- Meteorology satellites
- Military and security satellites
- Structural parts and tanks for launchers (Ariane 6)
- Small rocket ambitions (Rocket Factory Augsburg)
- ...



- Mini- and smallsats
- Standard components



- Mini- and smallsats
- Standard components



- Nanosats and components

Tapping Germany-specific demand

▪ Space Technology

- Match Finnish differentiation with German offerings
- Complement German NewSpace hardware integrators with downstream capabilities
- Fill potential gaps in DLR programmes and Federal Armed Forces sourcing

▪ Connectivity & IoT

- Solutions and business models for 5G infrastructure and applications (white spots)
- Industry 4.0, IoT and digitalisation solutions are in high demand

▪ Urban Development

- Limited potential

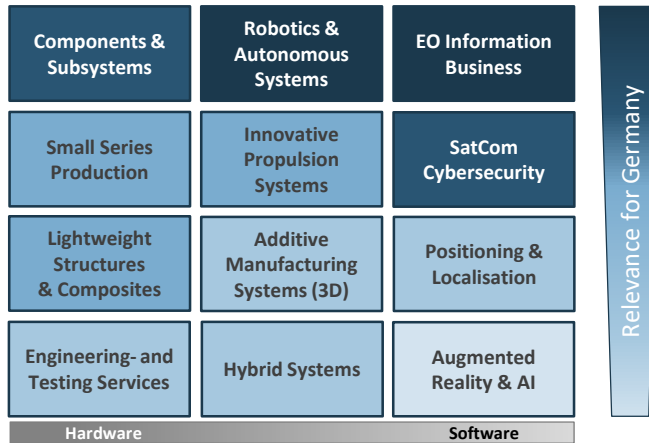
▪ Bioeconomy

- Possible potential in subdomains
- Work with German players in current technology revolution using Copernicus & Galileo for around Common Agriculture Policy (CAP)
- Pragmatic showcasing: Finland as 'Partner Country' e.g. at Grüne Woche / Agritechnica etc.

▪ Security

- Tap potential to use ICT in critical infrastructure security
- Support export-oriented German companies to deliver safe digital services

Aiming for cooperation in German NewSpace building blocks



Source: NewSpace Study for German Ministry of Economy

IoT Connectivity & IoT

Urb Urban Development

Bio Bioeconomy

Sec Security

Spa Space Technology













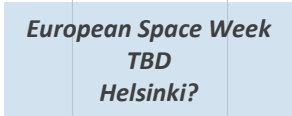





Source: SpaceTec Partners analysis, leveraging BMWi NewSpace Study

EO Information Business <ul style="list-style-type: none"> Unique digital terrain models (SAR technology) Specialist user know-how, solution and process competence, image recognition and change recognition Geo Cloud Platforms from Germany 	Robotic & Autonomous Systems <ul style="list-style-type: none"> Synergies with autonomous mobility Development of commercially operated "space habitats" Concepts for in-orbit maintenance
SatCom Cybersecurity <ul style="list-style-type: none"> Easier protection than terrestrial systems (KLEO Connect) Encryption expertise Laser communication (Tesat, Mynaric) 	Components & Subsystems <ul style="list-style-type: none"> Star trackers, inertial sensors, optics, radar etc. (BST, Jenoptronic) Actuators and control moment gyroscopes (Teldex, Astro- & Feinwerktechnik) Pressure control system (AST)
Innovative Propulsion Systems <ul style="list-style-type: none"> Research on electric motor controllers 'Green' Propellant (BayernChemie) Reputation for chemical products and gases (Messer, Linde) Synergies with the hydrogen economy (car/transport/air) 	Small Series Production <ul style="list-style-type: none"> Better price-performance ratio Process spin-in from precision mechanics, tool making, prototype production, etc.
Lightweight Structures & Composites <ul style="list-style-type: none"> Synergies with aviation and automobiles Know-how related to plastics and material bonds 	Additive Manufacturing Systems (3D) <ul style="list-style-type: none"> Competence in new production methods DMG Mori AG: used by Virgin Galactic EOS: In series production at SpaceX Super Draco LPKF: Rapid prototyping of printed circuit boards
Positioning & Localisation <ul style="list-style-type: none"> Excellent research: FhG, DLR World leader HERE: HD cards key to autonomous mobility Ambitions of suppliers: Bosch, Continental etc. Mobility oriented start-ups Domestic financial technology providers for authentication 	Engineering <ul style="list-style-type: none"> Unique technical facilities and know-how Interface to research Diagnostic capabilities, standardisation/certification know-how Existing capacities (testing, simulation) of service providers Export of manufacturing and test procedures for constellations
Hybrid Systems <ul style="list-style-type: none"> Laser communication technology High density of drone manufacturers (AscTech/Intel etc.) Advanced regulation for civilian drones Balloon and High-Altitude companies HQ for the aviation safety authority EASA in Germany 	Augmented Reality & AI <ul style="list-style-type: none"> Excellent research facilities Automation potential Successful companies with exits (Metaio/Apple)

Meet players in key (application) industry events in 2019

Industry Events

Space Events

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
 IPM ESSEN - GERMANY 22-25 January Essen			 25-28 April Leipzig					 12-15 September Gülzow-Prüzen		 10-16 November Hannover	
 GRÜNE WOCHE 18-27 January Berlin		 FORST live 29-31 Mar Offenberg		 LIGNA 25-27 May Hannover				 IAA 12-22 September Frankfurt	 Nieder bayern Schau Messe Landshut 2-6 October Landshut		
 ESA Investment Forum 30 January Darmstadt			 HANNOVER MESSE 1-5 April Hannover		 2019 EBAN Annual Congress 3-4 June Helsinki					 European Space Week TBD Helsinki?	
		 MUNICH SATELLITE NAVIGATION SUMMIT March 25 - 27, 2019, Old Congress Hall, Munich 25-27 March, Munich									
	 DRONE INSIGHTS THE UNMANNED AVIATION SUMMIT 12 Feb Berlin										
				 6. Nationale Konferenz Satellitenkommunikation 14-15 May Bonn							
								 INTERGEO GLOBAL HUB OF THE GEOSPATIAL COMMUNITY 17-19 September Stuttgart			
										 SPACE TECH EXPO EUROPE 19-21 November Bremen	